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DIPLOPODA FROM THE WESTERN STATES.

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FAMILY CALLIPODIDAE.

Lysiopetalum mutans sp. nov.

General color of body above dark brown to almost black; a narrow median line of yellow extending from the anterior margin of the second dorsal scutum to the end of the anal scutum; a broader pale stripe of darker caste than that of the median line along each side from the anterior margin of the first segment to the end of the body; lower portion of sides and the entire venter yellowish. Legs yellow on inner or ventral surface proximally, the distal articles commonly darker; dorsally brownish, likewise darker distally. General color of head brown; vertex areolate with dark-brown over a lighter ground; a smoky or blackish brown area between eye and antenna of each side and those of the other, the area narrowing to a median point down the front, the region each side of this elongation areolate like the vertex; clypeus and labrum light brown to yellow. Antennae deep brown or blackish excepting the two distal articles which are whitish.

Vertex of head crossed by a narrow median longitudinal furrow which is subdivided by a fine line-like elevation; head depressed transversely a little ventrad of bases of antennae; subdensely hirsute with short stiff hairs or setae which are somewhat longer in the clypeal region.

Gnathochilarium broad; greatest width of mentum 3½ times as great as the median length; lingual lamellae, exclusive of its processes, twice as long as the greatest width.

Eyes well developed, black, subtriangular; the ocelli numerous, compactly and seriately arranged. Below eye area proper on each side is what appears to be an organ of sense; it is much larger than an ocellus, convexly elevated and transparent, the convex portion apparently covering a pit in which is a conical body like a sense-cone of the antennae.

Antennae long and moderately clavate; clothed with mostly short hair intermixed with some longer ones; length 2 mm.

Body gradually attenuated from near anterior end of caudal third of the length cephalad, more abruptly narrowed or constricted over several segments immediately caudad of the head. Dorsum depressed or sub-complanate, rather more convex cephalad than caudad. Sides sub-vertical. A fine median dorsal keel extending from the anterior margin of the second segment to the caudal end of body. Each side of the median keel upon the dorsum are three conspicuously elevated, sharp edged carinae which extend entirely across the segment and each of which bears at its caudal end a short clavate seta projecting dorso-caudad; laterad of the outermost of these dorsal keels is a much thicker keel with wide flat surface which bears a similar seta adjacent to caudal end; between each two of these major carinae is an intermediate lower carina which bears no seta; on the side ventrad of the thickened carina above mentioned are two additional, large setigerous carinae and between the thickened carina and the first and between the first and second of these a lower non-setigerous carina; while ventrad of the second are other lower carinae which become obscure ventrad. Segments anteriorly transversely furrowed, the carinae over and cephalad of the furrow lower and weaker but continuous. On the second, third and fourth segments the setae are not borne at caudal ends of the carinae but spring from tubercles contiguous with the carinae at or cephalad of their middles and extend vertically from the surface or nearly so; on the fifth segment are two series of setae, one consisting of setae along caudal margin as on more posterior segments, and the second more cephalad as on the preceding segments, the setae of the two series alternating.

Collum or first segment in outline half-moon shaped, the caudal margin being straight and the lateral and anterior margins together evenly convexly rounded or semicircular. Carinae extending only across the posterior half of the segment, the setae being borne at their cephalic ends. A second series of setae toward the cephalic margin.

Anal plate triangularly narrowed caudad, the posterior margin truncate or weakly widely rounded and bearing the usual two long setigerous papillae; anteriorly, longitudinally carinate; bearing transverse rows of setae of which the most caudal become longer and conspicuously and finely drawn out apically.

Anal valves smooth; an obliquely transverse, somewhat curved impression over caudal portion on each side; each valve bearing two pointed setae, one at the caudal edge and one at middle toward the mesal margin.

Anal scale transversely somewhat diamond shaped, the meso-caudal and meso-cephalic angles a little rounded; a longitudinal, somewhat incurved, impression crossing each side; bearing two pairs of finely pointed setae, one median and between the longitudinal impressions and the other near the caudal margin with each seta laterad of the impression of the corresponding side.

Distal article of first and second legs in the female with a comb- or calamistrum-like series of setae along the ventral surface, the setae being very closely and regularly set.

In the female the coxae of the second to eighteenth legs inclusive and of the twentieth or, as appeared in one specimen, of the second to nineteenth legs inclusive, bear on their caudo-ventral faces conspicuous, distally inflated, sub-fungiform outgrowths; the processes of the third legs, however, reduced to smaller, low convex elevations.

Oviducts of female protruding as greatly elongated appendages or ovipositors which when extended caudad reach the eighth segment of the body; distal portion of processes enormously enlarged, bearing very long stiff bristles; proximally glabrous; showing a tendency to segment into articles; color white.

Number of segments 49 to 53.

Length 26 mm. Width 1.5 mm.

Locality—Stanford, Cal. (W. M. Mann).

FAMILY CRASPEDOSOMIDAE.

Conotyla deseretae sp. nov.

Dorsum brown; a dark band of black or bluish black color along each side immediately ventrad of the carinae, the band commonly extending dorsad on the prozonites and sometimes, especially on the posterior segments, forming thus a band entirely across the dorsum; a median longitudinal dark band along dorsum, and this typically geminated throughout its entire length by a narrow light line. Venter and legs paler, light brown to yellowish. Head commonly a considerably darker, more reddish, brown than that of the body. Antennae deep brown to blackish.

Head widely and shallowly depressed or furrowed transversely between the eye patches. Evenly hirsute with short hairs.

Lingual lamellae of gnathochilarium with sides sub-parallel for most of length; their length, inclusive of processes, three times the greatest width. Lingual stili conspicuous, their lateral teeth distinct. Spatula large, distally broadly rounded. Stipites a little less than five times as long as the greatest width. Mentum with greatest diameter somewhat more than twice the greatest length; its anterior margin widely rounded; as a whole sub-semicircular in shape.

Eye patches triangular, the apex directed forward; ocelli 25, more or less, arranged mostly in seven series (6, 5, 5, 4, 3, 2).

Antennae long, of typical form and proportions; length 3.5 mm. See Pl. XXXI, fig. 8.

Body strongly narrowed caudad and cephalad, the first segment constricted in the usual way; a sharp, low, median keel extending along dorsum for its entire length, a narrow furrow impressed each side of the keel. Second segment short, the inner bristles relatively farther laterad than on the first, and these bristles located more and more distantly from the median line on subsequent segments back to the middle region of body. The lateral bristles, as usual, becoming directed more and more strongly caudad in proceeding from anterior segments posteriorly. Inter-segments or prozonal divisions in part encircled by a series of fine transverse impressed lines, the elevations between these crossed with fine striations.

First segment somewhat semi-circular or sub-reniform, the anterior median region extending into broad excavation of head. Carinae very weak, continuous with the finely raised line of cephalic margin. The inner bristle on each side more than one-third the distance from the distinct longitudinal median keel to the outer bristles. The two outer bristles of each side upon carina, extending dorso-laterad and the caudal one in a transverse line with the inner ones.

Anal scutum truncate caudad, but the caudo-lateral angles extended, the intervening margin widely set in.

Anal valves equalling the scutum; the caudal margin of each nearly straight or but little curved, distinctly raised; an impressed longitudinal line toward dorsal margin and a similar one toward the mesal; three bristles borne a little cephalad of the caudal margin, the uppermost of these being close to the anal scutum, and the lowermost near the middle line of the valve.

Anal scale trapezoidal, the caudal margin wide, widely weakly incurved; a long bristle borne near each caudo-lateral angle.

First two pairs of legs of male slender, six-jointed as usual; the claws large; without special protuberances, and with no roughenings on the distal articles.

Third legs stout and, like the subsequent ones, seven-jointed; the ultimate joint roughened over the ventral and ventro-lateral surfaces, except proximally, with rows of short transparent processes; femur swollen into a wide enlargement on the dorsal side.

Fourth and fifth legs of male similar to the third but with the dorsal face of femora not bulging.

Sixth legs of male like the fifth but the coxae bulging ventrad.

Seventh legs of male with coxae strongly bulging ventrad into prominent rounded processes as shown in the figure (Pl. XXXII, fig. 6).

Anterior pair of processes of male gonopods broad plate-like structures with teeth along mesal portion of distal edge; posterior pair large, strongly inclined caudad, a secondary, somewhat flattened, accessory division along proximal portion of caudo-lateral surface; a conical process springing from the base of each (see Pl. XXXI, figs. 4, 5, and 6.)

Eighth legs or accessory gonopods with the distal article strongly enlarged as usual, the basal article more than commonly elongate, and extended ventro-mesad into a conical process which bears distad a number of very long bristles; below the conical process the proximal joint is shallowly excavated for the reception of a rounded protuberance of the posterior gonopod of the corresponding side.

Length 23 mm.; width 2.9 mm.

Locality—City Creek, Mill Creek, Provo and other canyons of the Wahsatch Mountains, Utah.

Conotyla coloradensis sp. nov.

Dorsum and sides brown, the prozonal divisions of segments somewhat lighter than rest; sometimes finely areolated with paler brown. Lower region of sides and the venter paler, light brown to yellowish. No black bands or spots. Legs yellowish proximally, the distal joints brown or marked with brown in spots and streaks. Antennae brown.

Head hirsute, the vertex more sparsely so than the frontal region.

Lingual lamellae of gnathochilarium widest anteriorly, incurved posteriorly, posterior arms a little divergent, three times as long as greatest width. Stipites five and a half or more times as long as the greatest width. Spatula conspicuous, distally subtriangular. Mentum one-half as long as greatest width.

Eye areas subtriangular, but with the sides convex; ocelli about 22, in five curved series, counting from outermost mesad as follows: 5,5,5,4,3.

Antennae very long, proportions as represented in Pl. XXXIII, fig. 2. Length 4.2 mm.

A fine median longitudinal keel over all segments excepting the last. Carinae increasing in size from the first caudad. Inner setae becoming relatively farther and farther from middle line in going caudad, these setae inserted in a wide longitudinal depression extending along each side, the dorsum between the depression a little convexly elevated. Setae, as usual, becoming directed more and more strongly caudad in proceeding from anterior to posterior segments.

First segment of the usual form, the anterior margin broadly extended cephalad mesally and fitting into excavation of head, the lateral portions of margin a little incurved. Carinae small, continuous with anterior margin of plate. Innermost bristle about one-third the distance from median to the edge of the carina of the corresponding side, in transverse line with the more anterior of the lateral bristles which is situated cephalad and considerably mesad from the posterior one, the latter close to the caudal margin. Segment considerably depressed or furrowed transversely, the inner setae located in this depression. Setae erect.

Anal scutum truncate caudad, the posterior margin weakly incurved.

Anal valves not equalling the scutum, widely rounded and broadly margined. The three bristles nearly equidistant, the most ventral three or more times as far from the ventral scale as the most dorsal is from the scutum.

Anal scale sub-trapezoidal, the lateral and cephalic margins weakly convexly rounded, the caudal distinctly incurved between the two long bristles.

Appendages of second segment of female conspicuous, strongly enlarged distad, the distal end with long bristles. A sub-lobe sheathing the cephalic surface of main appendage, this bearing long bristles apically. See Pl. XXXIII, fig. 7.

Locality—Colorado (T. D. A. Cockerell).

Tingupa gen. nov.

Antennae moderate, strongly clavate distally, the fifth article longest and much thickest, the third article second in length.

Eyes well developed, consisting of numerous ocelli (8-20) arranged subseriately.

Gnathochilarium with promentum well developed, triangular and moderately low.

Segments convexly arched dorsally and with well-developed carinae; dorsum covered with densely arranged, laterally compressed and in part conically pointed granules which extend to edges of carinae and on caudal segments may project as spinous processes from carinae and caudal margin of segments; setae moderate to long, clavate.

Segments in adult 30.

Type—*Tingupa utahensis* sp. nov.

Distribution—Two species known, the type from Utah and a second form, *Tingupa monterea*, from California.

The genus seems to have closest affinities with *Pseudotremia*.

Tingupa utahensis sp. nov.

General color brown, like that of the dead leaves among which it lives; in some with finer mottlings of paler color on sides. Venter pale. Legs from yellow or almost white to pale brown. Antennae brown, the articles often paler at distal ends.

Segments with major subdivision strongly granulate, the granules or scales mostly somewhat compressed laterally or elongate antero-posteriorly and closely arranged; similar but narrower elevations closely covering the dorsal portion of the minor subsegments; scales larger on posterior segments, series of larger ones with conical apices directed caudad as acute spinous projections. Segments mesally well arched, depressed immediately mesad of the carinae; entire dorsum weakly longitudinally furrowed, the furrow divided by a fine, at times almost obsolete keel. Segments bent cephalad laterally, the latero-cephalic margin widely rounded, the acute anterior angles situated close to body. Edges of carinae often appearing finely crenate or dentate from the presence of the projecting tubercles. All setae clavate, in proceeding from first to posterior segments the two lateral setae on each side become more extended in these directions, more strongly directed caudad and cephalad respectively, in some being horizontally extended in these directions.

Vertex of head crossed by a low, rounded, median longitudinal ridge; head also elevated along a line connecting the angles of the eyes; transversely depressed between bases of antennae; conspicuously and rather densely hirsute with moderately long stiff and erect hairs or setae.

Gnathochilarium with lingual lamellae inclusive of processes three and a fourth times as long as the greatest width. Stipites in length about 4.7 or a little less times the greatest width. Promentum moderate, triangular in general outline, the basal margin broadly angularly

excised. Mentum with distal border broadly angular, fitting into excision of promentum; greatest width apparently about three and a half times the mesal length, but the position of the sclerite and some difficulty in determining the proximal limit leaves room for some uncertainty.

Ocelli arranged in a narrowly sub-triangular patch, the apex directed mesad and toward that of the opposite eye; caudal margin shortest, a little convex, the dorsal margin convex near caudal margin and concave near apex or mesal angle, the ventral margin concave. Ocelli in four series, counting from ventral row dorsad as follows: 7, 6, 4, 3, giving all together 20 or thereabouts.

Antennae strongly clavate, the fifth article longest and thickest, the first three especially much more slender.

First segment clearly longer than the second, the cephalic margin mesally protruding, the lateral portions straight or but little concave. Caudal margin nearly straight, distinctly excised immediately mesad of carinal corners, the latter angularly projecting caudad or latero-caudad, the posterior of the two lateral bristles projecting caudo-dorsad and somewhat laterad from bottom of this excision. Depressed or widely furrowed longitudinally on each side between median line and the lateral margin, the anterior of the lateral bristles springing from the cephalic portion of its depression in a dorso-cephalic direction. The innermost bristle near cephalic margin and well toward the median, extending dorso-cephalad.

Anal scutum in outline as viewed from above somewhat trapezoidal, the lateral margins not strongly converging; caudad widely subtruncate, the lateral angles somewhat rounded. Papilla on each side nearly midway between the median line and the lateral margin, bearing a long curved bristle. A pair of long bristles borne on weak elevations each side of the median line and half-way between caudal and cephalic limits; and each lateral margin with a long bristle arising from near anterior angle and a weak tooth or acute obtuse bristle midway between anterior and posterior ends.

Anal valves with caudo-dorsal angle sub-acute, apically but weakly rounded, the caudo-ventral angle obtuse. Each valve bearing three long bristles, a little within the ventro-caudal margin, these bristles projecting caudad, the most ventrad being at the obtuse caudo-ventral angle or extension and closer to dorsal scutum than to anterior end of free margin, the other two equidistant from this one, with the upper one closer to scutum than to median bristle.

Ventral scale bearing two long, caudally directed bristles.

Anterior pairs of legs, in female at least, with distal joint bearing beneath a conspicuous comb-like series of stout bristles. See Pl. XXXIII, fig. 8.

Appendages of second segment large and distinct. Two sub-cylindrical processes springing from a main plate or fold and extending ventro-cephalad, these processes translucent or transparent distally. See Pl. XXXIII, fig. 7.

Length 7–8 mm.

Locality—Mill Creek Canyon, Utah.

Found among dead leaves along the margin of a deeply shaded ditch on south side of canyon, the accumulation of leaves remaining very damp.

Tingupa monterea sp. nov.

Dorsum dark brown, a row of light spots along each lateral margin, a spot being on edge of each carina, and two other rows, more or less evident, between this row and a pale median longitudinal line, the inmost row being close to the latter. Venter pale. Feet white or yellowish. Vertex of head dark brown, the other portions paler, yellowish. Antennae brown, the articles pale distally.

Segments bent first forward laterally and then again somewhat caudad distally, especially in case of the posterior segments, the lateral margins lying parallel with axis of body and not widely rounded or curved in mesad, the cephalo-lateral angles being in fact farther from the body than the caudal in most segments; a little incurved mesad of each caudo-lateral angle, but less conspicuously so than in utahensis. Segments, excepting first and last, with a fine longitudinal keel along mesal line. Carinae strongly developed and conspicuously extended laterad and meeting together rather closely; finely denticulate. Granules or scales covering the segments densely in compact rows, their conical apices projecting like minute spines, at times giving the appearance of hirsuteness when viewed parallel to surface of segment, the whole surface thus appearing finely spinescent. Setae long and clavate, situated nearly as in utahensis.

Anterior margin of first segment bow-shaped, being mesally moderately curved cephalad or convex, then each side concave, and lateraly again convex. Not mesally furrowed or keeled.

Anal segment as viewed from above with the sides strongly converging caudad, incurved; widely truncate caudad; a large mesal tubercle or elevation a little cephalad of caudal margin.

Anal valves appearing a little to exceed the scutum. Dorso-caudal angle widely rounded, the free margin first curving evenly ventrad and cephalad and then running straight cephalad parallel with the dorsal margin. Dorsal and ventral edges elevate, the caudal not so.

Head with vertex elevate, somewhat longitudinally rugose along caudal border. Conspicuously depressed on each side from base of antenna caudad, the antenna being inserted in anterior end of the furrow. Head densely hirsute with short setose hairs over entire surface, sometimes appearing a little sparser on vertex.

Eye area small; the ocelli numbering eight or thereabouts, arranged in three series, counting from above toward antenna, 3, 3, 2; the side of patch toward median and that toward dorsal surface subequal, each consisting of three ocelli, and the two lying at right angles to each other or nearly so.

Antennae short, strongly clavate, the fifth article decidedly longer and very much thicker than the third.

Gnathochilarium with lingual lamellae, inclusive of processes, about 3.8 times as long as the greatest width which is anteriorly. Stipites inclusive of processes, about 4.25 times as long as the greatest width. Greatest width of mentum apparently three times the length, though the caudal margin was made out with some uncertainty. Promentum distinct and well developed. Spathula evident. Stili not detected.

Size approximately that of T. utahensis.

Locality—Pacific Grove, California (June, 1902.)

Caseya irritans sp. nov.

General color in alcohol light brown; indications of pale, whitish transverse bands, one across each segment, and of a row of whitish spots laterally. Venter and the feet yellowish. Head with the vertex pale, finely areolated in brown; frontal region brown, a distinct pale spot ventro-mesad of each antenna, the spot transversely elongate, and a median pale spot immediately dorsad of the inner ends of these two spots; clypeal region pale; labrum yellow.

Head widely excavated caudad. Vertex transversely elevated, smooth and shining in the specimen as at present, crossed by a faintly developed fine median longitudinal line. Frontal and clypeal region of head sub-complanate; a conspicuous transverse impression above clypeus, indented or bent dorsad mesally.

Eye patch elongated in a meso-ventral direction. Ocelli strongly developed, 13 in number and arranged in three series, which, counting from above toward antennae are as follows: 7, 5, 1; on one side the series appearing rather as four, 1, 6, 5, 1.

Antennae long and slender, scarcely clavate. The third article much longer than the fifth; the seventh much smaller than the sixth, being but little more than half its length.

Promentum moderately large, triangular; mentum a little less than three times as wide as the median length. Length of lingual lamellae, inclusive of processes, a little less than three times as large as the greatest width, which is caudad of the middle. Stipites, inclusive of processes, about 4.4 times as long as the greatest width. Sensory cones of outer process of stipes 5 or 6 in number, of inner process apparently 6. Stili not detected.

First dorsal scutum sub-reniform, the anterior median portion rather narrowly protruding. Caudal margin with lateral angles evenly rounded, the median portion almost straight, slightly obtusely indented at mesal line. A fine median longitudinal line impressed across caudal portion of plate. Lateral regions of segment marked with numerous fine oblique striae, there being similar striae on the anterior rounded median portion but these extending but little caudad.

Body fusiform, attenuated both caudad and cephalad.

Segments caudad of the first with numerous striae over sides beneath; on the second there are three striae above the obsolete shoulder-like bulging occurring where carina would usually be developed, on the

third four or five, the striae existing farther and farther dorsad on subsequent segments, from the fifth caudad extending completely across the dorsum. From the fifth segment to the ultimate a band-like area across dorsum marked apparently with coarser striae and distinctly delimited laterally; on the more caudal segments the band extending caudad a little beyond the usual limit of segments and presenting weak crenations or dentations, the band farther cephalad on segment in median and anterior region of body.

Anal scutum in outline as seen from above with sides converging caudad, nearly straight or but little incurved mesally; caudal margin mesally emarginate. Two impressions extending from anterior margin on each side of the middle and converging to meet in an acute angle at a mesal point on the caudal emargination of plate. Papillae slender, gradually acuminate.

Each anal valve crossed longitudinally over dorsal portion by two or three striations. The caudo-ventral edge nearly straight, margined.

Length, 10 mm. Greatest width 1.5 mm.

Locality—Portland, Oregon (Aug., 1902). One female.

FAMILY STRIARIIDAE.

Striaria nazinta sp. nov.

Body uniform light brown in color. Legs yellow. Antennae white.

Body cylindrical, gradually attenuated cephalad as well as caudad.

First segment large, expanded on each side in a plate which extends cephalad over lateral portion of head. Mesally the front margin is straight or nearly so. Anterior border with a ridge-like elevation continuous laterally with edges of the lateral plates, the two ridges meeting in a mesal elevation and at an angle open cephalad, the surface of plate in front of this elevation obliquely descending to head, closely tuberculate. On main area of plate each side of the median line are six strongly elevated and relatively thin carinae of which the one nearest the meson is lower and begins farther cephalad than the next laterad; the farthest laterad of these carinae is much lower and shorter than any other and is the only one not attaining or nearly attaining the caudal margin. Laterad and cephalad of the carinae and to the very edges of the lateral plates, the segment is densely tuberculate. Between the carinae the granules are irregularly scattered, and relatively few, not in definite rows, though they may usually be regarded as representing two broken series in each interspace.

Second segment with twelve dorsal and dorso-lateral carinae in addition to the major lateral carinae, but crossing the entire width of the major sub-segment and, as on all subsequent segments, more strongly elevated at caudal ends. Lateral carinae or plates less strongly extended horizontally than the lateral plates of first but in general similar, the lateral portions less strongly granulate.

Third and subsequent segments with twelve dorsal and lateral carinae in addition to the lowermost pair, the latter not at all carried

out on horizontal plates or extensions like those of first two segments but reduced and comparable in size to the one immediately dorsad of it, and projecting cephalad instead of caudad as do the other carinae. These segments with only scattered and weakly developed granules, some appearing almost smooth. All marked with the usual fine median keel.

Anal scutum conspicuously granulate with strongly developed tubercles.

Anal valves not equalling the last dorsal scutum, narrow and elongate. Granulate with strongly developed tubercles similarly to the anal scutum.

Caudal margin of head straight, not at all excavated. Vertex of head transversely elevated, the lateral portions ridge-like, the ends abrupt and conspicuous, while the mesal portion of the elevation extends ventrad and narrows to a mesal point attaining the imaginary line connecting the bases of the antennae, in front of which extension the level is depressed. Vertex crossed by a narrow median longitudinal furrow. Entire head granulate, the lateral portions more coarsely so. Hirsute, more strongly so over clypeus and adjacent region.

Labrum set off by a transverse depression or furrow; lateral portions rounded; mesally with two conical teeth.

At each lateral end of transverse elevation of the vertex a small darkened area apparently representing an eye; but in the type specimen ocelli indistinct, three or four obscurely indicated areas apparently representing them, the granular character of the general surface making their certain identification difficult.

Antennae short; strongly clavate; appressed close to head and inconspicuous. Fifth segment longer and much stouter than the third; the seventh smaller than the sixth. Subdensely hirsute with short stiff hairs, the proximal articles rather more sparsely clothed.

First legs bearing along the cephalo-ventral surface a calamistrum-like row of stout setae, elsewhere with fine hairs which are more sparse on proximal joints. A moderate tuberculate elevation toward distal end of femur on ventral surface like those present in males of some craspedosomatids.

Other legs mostly but sparsely provided with hair; all tuberculate.

Length, 13 mm. Width, 1.2 mm., nearly.

Locality—Portland, Oregon (Aug. 1902). One female specimen.

FAMILY XYSTODESMIDAE.

Fontaria tuobita sp. nov.

Black, the carinal and lateral margins narrowly bordered with pale. Anterior portion of prozonites yellowish. Sometimes the black of the dorsum is in varying degrees supplanted with brown which encroaches in irregular streaks and spots. Sides paler, smoky yellow, the dark color more pronounced adjacent to bases of legs and on caudal segments or forming distinct bands down each segment in alternation

with the bands of yellow of the prozonites. Venter pale. Legs yellow. Vertex and frontal region of head dark, a background of yellow being closely covered with a network of black; clypeal and labial region yellow.

Head with median furrow of vertex sharply impressed, extending to an imaginary line tangent to the dorsal edges of the bases of antennae where it touches the mesal angle of an impression extending between antennae. Finely hirsute.

Antennae slender, rather short.

First dorsal plate a little narrower than the second. The lateral and cephalic margins together forming an even semicircular curve; caudal margins of carinae oblique, the intervening caudal margin of segment nearly straight. Mostly smooth and shining, finely rugose along cephalo-lateral border.

Dorsum well arched, the carinae somewhat depressed below the horizontal. Second segment with cephalo-lateral and caudo-lateral angles a little larger than rectangular, narrowly rounded. In subsequent segments the cephalic border adjacent to cephalo-lateral angles becomes more and more protruded cephalad, and the caudo-lateral angles become more and more produced caudad in an acute angle or process.

Anal scutum terminating in a cylindrical process which is curved ventrad and is truncate distally.

Anal valves strongly raised along free mesal margins.

Anal scale triangular, the lateral margins convex proximally, elsewhere nearly straight; caudal angle narrowly extended a little and rounded.

Ventral scuta transversely impressed, more strongly so on caudal segments; a little extended at a small elevation or process at base of each leg.

Gonopods of male with the coxae relatively large and stout, distad of this extending ventro-cephalad; narrowed distad and terminating in a blunt pointed process which curves mesad and a little ventrad and then toward apex bending back proximad. On the ventro-mesal surface at one-third the length from coxae, an acutely-pointed, blade-like process, which curving meso-ventrad and then distad crosses its fellow in the middle line. See further, Pl. XXXV, figs. 7 and 8.

Length, 19 mm. Width 4.5 mm.

Locality—Cloudcroft, Sacramento Mountains, New Mexico (Sept. T. D. A. Cockerell).

FAMILY POLYDESMIDAE.

Scytonotus piger sp. nov.

Dorsum dark, sometimes of reddish caste. Venter but slightly or not at all paler than the dorsum. Legs uniform brown or yellow. Head and antennae dark brown.

Head roughened. Vertex crossed by a short median longitudinal impressed line. Hirsute with short stiff bristles which are rather uniformly arranged.

Antennae clavate. Moderately to sub-sparsely clothed with mostly short hairs.

First dorsal plate less in width than either head or second dorsal scutum but relatively wider than in granulatus. Somewhat semicircular in outline but at each side extended into a narrow carina which is dentate, there being commonly two major teeth of which the caudal has a minor or secondary denticle on its posterior edge and in front of the anterior of which are several small denticles. Front margin mesally sub-straight, laterally convexly rounded.

Depressed along the cephalic margin, the depression extending caudad mesally and narrowing to a furrow which again expands triangularly adjacent to the caudal margin. The segment elsewhere elevated. Densely covered with tubercles, the setae much as in granulatus.

Second segment with the lateral ends curved cephalad and embracing the first. Segment longer laterally than mesally. Bearing three transverse rows of large tubercles. Carinae with cephalic angles acute but caudally widely rounded; laterally showing eight or nine rather small crenulations, the incision between them shallow; no translucent margin such as is present in granulatus.

Subsequent segments gradually increasing in length and showing from three to five or six transverse rows of tubercles. Posterior angles of carinae becoming less widely rounded and extending farther and more acutely caudad, in the last few segments being a little produced. Lateral margins of carinae with small crenulations or teeth which for the most part are well rounded and not at all acute; teeth or crenulations numbering from eight to ten or twelve, the lesser number occurring on the spiraculiferous segments. Prozonites very finely and densely granulate.

Anal plate convexly elevated proximally, bearing separated rows of conically pointed tubercles; two tubercles projecting laterad at base or proximal end of the cylindrical apical portion of scutum, this portion being slightly depressed ventrad and apically rounded and bearing on caudal surface four setigerous tubercles.

Anal valves with mesal and caudal margins elevated and smooth. In some an irregularly oblong area over posterior portion of each valve roughened with sharply separated depressed areolae. A setigerous tubercle in furrow near caudo-mesal angle and a second similar one near middle of plate nearer mesal than dorsal margin.

Anal scale with caudal extension convexly rounded and bearing two setigerous tubercles. Lateral portions in outline something like that of the fore part of a shoe.

Length 12–13 mm. Width ad 2 mm.

Locality—Upper branches of Mill Creek Canyon, Utah.

A number of specimens were obtained about springs in upper side branches of the canyon. It seems to be close to *S. granulatus* though clearly distinguishable in numerous details.

Polydesmus (**Kepolydesmus** subgen. nov.) **anderisus** sp. nov.

Brown to dark reddish brown; carinae along lateral edges and above of lighter color, often yellowish, the pale bands commonly more distinct caudad and frequently extending mesad along the caudal margin of each segment; often some of the anterior segments are dorsally distinctly areolated with black, which may form a more solid transverse band along the cephalic margin excepting its lateral ends. Venter pale. Legs yellow or light brown. Head brown, a dark blackish band between the bases of the antennae, this band concavely excised on ventral side; labral region yellowish. Antennae darker than the legs, being concolorous with the dorsum of body.

Vertex of head crossed mesally with a sharply impressed, distinct longitudinal furrow. Vertex and frontal region sub-sparsely clothed with short setose hairs, the clypeal region more sparsely provided with longer hairs.

Antennae long; a little clavately enlarged distad.

Body gradually narrowed cephalad from about the twelfth segment, less strongly so caudad.

First dorsal plate scarcely narrower than the head inclusive of genae, its greatest width about 2.3 times the mesal length. Anterior margin mesally straight or nearly so, the lateral angles widely rounded. Caudal margin slightly and widely mesally incurved, laterally extending gradually cephalad to meet the lateral margin at a rounded angle. Entire border of margins depressed. A transverse impression caudad of the cephalic border, a broad median longitudinal depression extending from this to the depressed border along the caudal margin. The rows of minute setigerous granules distinct, somewhat uneven; but the main tubercles very obscure or not at all indicated. Segment finely roughened laterally. Each lateral margin with a single minute denticulation.

Second segment bent cephalad on each side. Antero-lateral corner sub-rectangular as is also the cauda-lateral, but the latter well rounded. Sharply margined laterally, caudally and also along lateral portions cephalically. Lateral margin of carina with one distinct denticle at antero-lateral angle and one or two faint or obsolete crenulations or denticles indicated farther caudad.

Third segment nearly as the second; but the anterior margin immediately mesad of the cephalo-lateral angle more rounded and with a small indentation.

From the second segment caudad the cephalo-lateral angle becomes more and more rounded and the caudo-lateral less and less so, the latter finally becoming somewhat produced though not acute. The produced caudo-lateral angle of the penult segment somewhat indented caudally. Segments dorsally depressed mesad of the carinae, the depression anteriorly bending obliquely cephalo-mesad. Carinae bent a little dorsad. Transverse furrow deep and distinct, extending across dorsum about half way from meson to each lateral margin. Tubercles not sharply delimited, but rather more distinct on caudal segments.

Anal scutum with four denticulations along each lateral margin, each of these teeth bearing a stout seta. Dorsal surface with transverse rows of setae. Caudal process of the scutum straight, bearing four long, finely pointed setae.

Ventral plates impressed with the usual transverse furrow and with a less distinct longitudinal one. Smooth except for a moderate clothing of hair.

Legs rather long and slender, the second article inflated.

In the male the first two pairs of legs are conspicuously smaller and the ultimate joint is clothed within with stout setae subseriately arranged, the row being more even and well marked on the second. Other legs on inner surface with rows of setigerous tubercles, the setae being short, otherwise with sparse short hair only, except on the proximal articles. Second legs showing a cone-shaped, apically truncate process on the ventral surface of coxa.

For structure of copulatory appendages of the male see Pl. XXXVII, figs. 2, 3, and 4.

Length of female, .26 mm. Width, 3 mm. Length of antennae ad 3.8 mm.

Locality—Kendrick, Idaho (W. M. Mann).

Polydesmus (**Kepolydesmus** subgen. nov.) **sontus** sp. nov.

Dorsum deep brown to almost black, the prozonites mostly paler; carinae yellow. Pleural region between carinae and the bases of the legs brown. First segment commonly darker than the adjacent ones, often black, the caudal and carinal borders and the minute setigerous granules yellowish. Venter and legs yellow. Head with the vertex dark brown to blackish, the dark area extending forward between the antennae as a narrow, median tongue-like band, the color commonly deeper at the base or proximal end of this band; sides of head dark, a yellow band between dark area of vertex and the sides extending obliquely forward over insertions of antennae to the yellow lower frontal and clypeal area. Antennae yellow to brown, the sixth and seventh articles commonly conspicuously darker, the seventh being black and the sixth dark brown to black.

Body gradually attenuated cephalad; over posterior portion with the sides subparallel excepting for the few last segments which are narrowed in the usual way.

Vertex of the head crossed longitudinally by a fine median impressed line which extends almost to an imaginary line tangent to the upper edges of the antennal sockets. Frontal and clypeal region clothed with setose hairs of moderate length, the vertex appearing glabrous or nearly so.

Antennae short, a little less than or at most equalling the width of the body. Scarcely clavate. Sub-sparsely hirsute, the hairs more dense on the flexed side.

First dorsal plate in outline semi-circular or half-moon shaped, but the caudal margin a little incurved. Wider than the head inclu-

sive of the genae. Anterior border margined. Carinae narrow; bent dorsad; lateral margin with a single emargination but with no real denticulation. Crossed by a fine median longitudinal line.

Second segment bent forward at the sides. The anterior angles of the carinae sub-rectangular, somewhat rounded, overlapped by the first plate. A small denticulation on outer side of the cephalo-lateral angle and two weak or obsolescent emarginations indicated farther caudad. Caudo-lateral angles not rounded, a little obtuse. Caudal margin of carina excavated or abruptly bending meso-cephalad. Carinae rather narrow, bent somewhat dorsad. Inter-carinal region of dorsum strongly elevated and convex as it is on subsequent segments.

Lateral margin of carina of third segment shorter than that of the second. Anterior angle rounded, the emargination caudad of it as on the second segment, the denticle in front of the emargination likewise low and rounded. Posterior angle rectangular or acute. Caudal margin of carina straight, extending cephalo-mesad without showing any curvature.

Fourth segment similar to the third but the lateral carinal margin longer, sub-equal to that of the first, and the caudal angle rectangular or slightly obtuse. Only the single anterior emargination indicated.

Fifth segment abruptly longer. Lateral carinal margin bulging laterad, being mesally very obtusely angular. Caudal angle obtuse and rounded. The anterior emargination very weak.

Sixth segment a little longer than the fifth, the lateral carinal margin but weakly and evenly convex. The emargination very faint.

Subsequent segments sub-similar but the emarginations not at all manifest. The caudal angles in proceeding caudad become more and more acute and finally extended or produced sharply. All but a few of the segments with the dorsal transverse sulcus sharply impressed and extending well toward the carinae where it becomes more indistinct. A median longitudinal impression which is distinct in front of the transverse sulcus which is mostly vague or absent caudad of it.

Anal scutum with the process truncate and apically the caudal end shallowly emarginate.

Anal valves with the caudal margin a little incurved, meeting the mesal margin at an acute but rounded angle. Mesal margin elevate. A short curved impression near the mesal margin of each valve and about the middle of its length, the concave side being mesad. A longer and also slightly curved impression toward dorsal margin, the concavity being dorsad or ectad.

Anal scale relatively long, the caudal border emarginate. Laterally weakly emarginate at proximal ends of sides.

Ventral plates with a longitudinal median impression which is distinct on the posterior segments but is indistinct or not at all evident cephalad. Transverse impression mostly very weak. All rather densely clothed with hair, some of which is conspicuously long.

Legs sparsely clothed with short stiff hairs which are most abunant on distal joints and on the ventral or inner side.

In the male the first legs are, as usual, small, but the second are not conspicuously reduced. The bristles on the ventral surface of the distal joint of first legs more densely and sub-seriately arranged than on the others.

Copulatory appendages of the male moderately small, strongly bent cephalad and parallel with the body. The main outer process of each side bearing distally three chitinous appendages. The most proximal of these is short and blade-like and extends dorso-mesad and a little cephalad, crossing with its mate at the middle line. The second takes its origin cephalad and dorsad of the first and as a long, conspicuous, flattened and somewhat twisted blade extends first cephalad and then curves ventro-mesad. The third takes its origin a little dorsad from the base of the second and curves first dorso-mesad and then ventro-mesad, the distal portion curving finally ectad again and ending in a slender acute point. From the ventral concavity of this appendage springs a slender process which bears distally a stout curved seta which extends caudad to end in the neighborhood of the first process. See further Pl. XXXVIII, figs. 2 and 3.

Length 19-20 mm. Width 2.5 to 2.7 mm. Antennae ad 2.5 to 2.7 mm.

Locality—Los Angeles, Cal. (June, 1909.)

Polydesmus amandus sp. nov.

Segments with the main dorsal divisions whitish, a tendency for the median area contiguous to the cephalic margin to be brown, the ultimate segments and a few of the most anterior commonly more or less completely brown; the prozonites clear brown. First dorsal plate clear brown. Venter white, excepting a few of the most caudal and of the most anterior segments which are brown. Legs white but with the coxae all brown and with a decided tendency for the distal articles likewise to be brown or brownish. Head uniform brown, the color being of a lighter shade than that of the first segment. Antennae uniform brown or with some of the median articles whitish in whole or in part.

Head nearly smooth, the vertex crossed longitudinally by a short median impressed line. Clothed rather densely over nearly the entire surface with very short hairs.

Antennae a little longer than the body is wide. Clavate, the sixth article being considerably the thickest.

First dorsal plate narrower than the head inclusive of genae and than the second segment. Transversely sub-elliptical. Lateral carinal margin with three teeth; a fourth tooth projecting from edge on the cephalo-lateral curve. Tubercles in numerous rows; strongly developed; apically acuminate and setigerous. The setae curved or frequently hooked distally. A transverse impression or sulcus cephalad of the row of tubercles along caudal border.

Second segment strongly bent cephalad at the sides. On the carinal margin immediately caudad of the acute denticle of the cephalo-lateral angle is a more obtuse one and caudad of this five larger, low

crenations which are continuous as a series with a row of crenations or projecting tubercles along the caudal margin; all are setigerous. Tubercles all strongly developed. Carinae sub-horizontal.

Carinal margin of the third segment rather longer than that of the second but similarly sculptured.

Subsequent segments becoming longer, the rows of tubercles they bear more numerous, the carinal crenulations weaker, and the caudo-lateral angles more rounded excepting in the last few where they tend toward rectangular. In the antepenult segment alone are the caudo-lateral angles a little produced. A transverse sulcus between the second and third or the third and fourth rows of tubercles from the caudal margin. Two longitudinal impressions, one a little each side of the median, extending from cephalic margin a short distance caudad and then curving out laterad. Wide spaces intervening between the carinae of adjacent segments.

Anal scutum bearing transverse rows of strongly developed, conical setigerous tubercles like those of other segments, these rows well separated from each other. Apical process of scutum decurved, conical, not truncate, and bearing long setae as usual.

Anal valves with the dorsal and mesal margins sub-parallel, the caudal margin meeting the mesal in a rounded but as a whole somewhat acute angle. A little cephalad of the caudo-mesal angles is a transverse impression crossing the median line from valve to valve. Mesal margins strongly elevated. A conspicuous conical and setigerous elevation near the middle of each valve, this elevation closer to the mesal than to the dorsal margin.

Anal scale with each half in outline like that of shoe with high instep. Caudal margin crenately incised a little mesad of each caudo-lateral angle, the crenulation adjacent to each angle bearing a long seta.

Ventral plates pilose. The transverse impression in most more strongly developed than the longitudinal.

Legs rather long, very sparsely hirsute proximally but more densely so distally. Second and third articles inflated dorsally.

The first legs reduced as usual, the second intermediate in size.

Gonopods of male of moderate size. Each one presenting two main chitionous processes of which the cephalo-mesal one is apically bidentate and presents near its base an acute conical tooth projecting in a cephalo-mesal direction. The second process lies against the first for most of its length but distally diverges from it, extending more directly ventrad and ending in an acute point. See further Pl. XXXVIII, fig. 6 and Pl. XXXIX, fig. 1.

Length of male 18 mm. Width 1.9 mm. Length of antennae 2+ mm.

Locality—Mill Creek Canyon, Salt Lake Co., Utah. (Sept., 1900).

Polydesmus sastianus sp. nov.

Dorsum brown; the carinae paler, yellowish. Sides pale brown. Venter and legs yellow. Head light brown. Antennae light proximally, the distal joints brown.

Head finely roughened. The vertex crossed with the usual impressed line. Clothed rather densely with very fine short hairs.

Antennae short. Clavately thickened. Distal articles sub-densely clothed with moderately short hair; but with only a few hairs on the first and especially on the second articles. The four sense cones conspicuous.

First dorsal scutum narrower than the head and also distinctly narrower than the second segment. Transversely sub-elliptical with the caudal margin, however, but little convex. Tubercles strongly developed, conical, in crowded series. The setae conspicuous, those of the rows of tubercles along cephalic and caudal margins very long and, as usual, curved or hooked distally.

Second segment not strongly bent forward laterally. The conical tubercles strongly developed and densely arranged as on the first one. Carinal margin with the anterior and the posterior angles about equally rounded; laterally with six, large, angular, setigerous teeth, of which the most cephalic, which is located on mesal side of cephalo-lateral angle is smallest and most acute, the fourth and fifth with a secondary indentation on their cephalic edge and three similar teeth on caudal side. The series of teeth continued along the caudal edge of plate by a row of large projecting tubercles.

Third and fourth segments with their lateral margin shorter than that of the second; the caudo-lateral angle of carina more rounded; lateral margin with same number of teeth as the second.

On the subsequent segments the caudo-lateral corners of the carinae become more angular, first becoming sub-rectangular and then on the last two preceding the anal plate a little produced caudad. Entire dorsum with a longitudinal median keel-like elevation which is better developed on the prozonites. Transverse sulci rather weak.

Anal scutum strongly tuberculate, the tubercles conical and setigerous like those of the preceding segments. Caudal process narrowly rounded.

Anal valves somewhat as in the preceding form.

Anal scale sub-triangular. Caudal angle a little rounded. Seven pairs of setigerous tubercles along the lateral margins.

Most of the ventral plates are very distinctly marked both with the transverse and with the longitudinal impressions; of these impressions the longitudinal one is narrower and usually appears more sharply impressed.

Legs moderately clothed with rather short hair, the first two joints more sparsely so.

Length: 10–11 mm. Width 1.5 mm. Length of antenna ad 1.5–1.6 mm.

Locality—Shasta Springs, Cal. (Aug., 1909.)

Three specimens were secured, one adult female and two not fully grown males.

Polydesmus socarnius sp. nov.

Dorsum brown; the carinae commonly paler; a median longitudinal dark line indicated in some, this more distinct caudad. Venter scarcely paler than dorsum. Legs yellow or light brown. Head brown, the genae and the clypeal and labial region paler, yellowish. Antennae brown, darker than the legs, but light distally.

Vertex of head crossed by the usual median longitudinal impressed line, this line extending to the angle between two furrow-like impressions which extend from the median ventro-laterad to the bases of the antennae. Head conspicuously longitudinally furrowed along each side in line with the antenna, the latter being inserted in the furrow. Somewhat finely rugose over vertex. Moderately pubescent with rather short hairs.

Antennae a little longer than the width of the body, clavate to the sixth joint, seventh article comparatively large, showing the usual sense cones distinctly. Clothed densely with mostly short hairs.

First segment wider than the head without the genae but distinctly narrower than the head inclusive of the genae and than the second segment. Transversely somewhat elliptical; the cephalic margin widely and but weakly convex; cephalo-lateral angles strongly rounded, the margin evenly curving to the middle of the lateral carinal edge where it ends on each side in the single obtusely angular tooth. Caudo-lateral corners of the carina sub-rectangular, the caudal margin of the carina being nearly straight, untoothed. A row of four contiguous tubercles adjacent to the caudal margin along its median portion. The median convex area of segment with tubercles weakly or but obscurely indicated.

Second segment bent cephalad laterally as usual; overlapped by the first plate. Lateral carinal margin with three strongly developed teeth of which the cephalic is most acute and of which the most posterior is at or but little caudad of the middle of the margin, the latter caudad of this tooth being straight or but little curved to the sub-rectangular caudo-lateral angle. Posterior edge of carina straight and untoothed. Three rows of tubercles which are not closely placed, the two first rows extending from carina to carina; the row along the caudal border consisting of six elongate and roundly conical tubercles, which project a little beyond the caudal margin and are widely separated from each other, the two more median ones being closer to each other than are any other two.

In the following segments a fourth tooth, at first ventral in position, occurs between the caudal angle and the median tooth of the carinal margin. The caudo-lateral angle becomes gradually more and more acute and extended caudad, on most of the segments being conspicuously produced. Most of the segments typically with a narrow longitudinal furrow adjacent to the carinal margin, a little mesad of this with a wider and deeper furrow and again a little farther mesad a second narrow furrow, there being between the large and more evident furrow and the narrower one each side of it a carina-like elevation which

is commonly rather conspicuous. Dorsum as a whole complanate. Carinae a little elevate dorsad.

Anal plate with distal process apically decurved.

Anal valves with the mesal edges strongly margined and elevated. The usual setae present.

Anal scale sub-triangular.

Ventral plates with the usual cruciform impression, the transverse furrow being the wider and deeper in most plates.

Legs clothed with short stiff hairs, this rather longer and more abundant on distal joints.

Length, 10–11 mm. Width, 1.3–1.4 mm. Length of antenna ad 1.6 mm.

Locality—Salt Lake City, Utah (June 23, 1900).

FAMILY PARAIULIDAE.

Paraiulus zakiwanus sp. nov.

Color brownish red. The first segment clear reddish without darker markings; but most of the body subsequent to this with a row of black dots along each side, one to each segment, which on the more posterior segments is supplemented with an area of smoky or blackish which tends to extend or diffuse about the segment and thus much to darken it. No distinct median dorsal line and no light spots. Vertex of the head dark, a band between the eyes darkest, black; the head elsewhere reddish, the red intruding into lower border of the dark area in three semicircular incisions. Legs brown.

A sharply impressed furrow extending from the upper margin of the eye area mesad curving evenly mesad and then bending sharply back dorsad to meet its fellow at an angle on the mesal line; the median longitudinal line extending distinctly to this angle. A second impressed line a little cephalad of the caudal margin of the head, this line being bent forward at a sharp angle mesally. Head very finely rugose.

Eyes are large, sub-triangular, the ventro-lateral side and the caudal side convex, the mesal being concave. Ocelli 63-65, arranged in nine transverse series which, counting from above ventrad are as follows: 11, 10, 9, 9 (8), 7, 6, 5, 5 (4), 3.

First dorsal plate with the lateral margins not angularly produced beneath but nearly straight and subparallel with the axis of the body. Entire border of plate distinctly margined. Finely rugose or nearly smooth, not at all striate.

Second segment with four deep striae on each side beneath and on caudal division, the lowermost margining the lower edge.

Subsequent segments also deeply striate beneath, the striae well spaced apart.

Spiracles rather small; touching the transverse suture which is bent at their level.

In the male the sixth and seventh segments are moderately extended beneath the lower margin of the latter evenly convex in outline, not at all angular.

First legs of male strongly enlarged as usual. Uncinate. Inner surface covered with rounded tubercles which are arranged in transverse rows as shown in Pl. XL, fig. 4.

Second legs of the male with the coxae much enlarged in the usual manner; produced mesally into a long tongue-shaped process which distally is enlarged and sub-truncate and which extends ventro-cephalad between the legs of the first pair. Claw of legs small, concealed with hair which clothes the distal end of legs sub-densely.

First pair of gonopods in the male with the anterior division much shorter than the posterior, strongly and subquadrately enlarged distad and clothed densely with long hairs. The anterior branch with the more slender distal portion bent first mesad almost at right angles and then caudad parallel with the axis of the body, drawn out distally to a narrow, slightly rounded point, the lower margin of the mesally extending division irregularly toothed. See Pl. XL, figs. 1, 2 and 3.

Second pair of gonopods inserted a considerable space from the base of the anterior pair, above base curving forward parallel to the body and then curving ventrad in engagement with the inner branch of the first pair. From about the end of the first third of the length arises a slender process which in lateral view appears to terminate in a spear-shaped head, this process crossing the main branch in a caudo-dorsal direction. Main process terminating in two branches, a broad plate-like branch through which the duct opens and a more slender acute process springing from the ventral aspect of the former. See further Pl. XXXIX, figs. 6 and 7.

Width of body 2.6 mm. Length uncertain, the caudal end of the body missing.

Locality—Sacramento Mountains, New Mexico. (T. D. A. Cockerell.)

Paraiulus tiganus sp. nov.

Deep brown to almost black. A yellow to white stripe encircling the body at junction of adjacent segments and a narrower line-like ring of same color encircling each segment near transverse suture. On the dorsum of each segment each side of the median and on the anterior portion of segment is a curved light line, the concavity of which is caudad. A dorsal median longitudinal line of black which is thickest on each segment between the mesal ends of the two curved light lines. A row of black dots along each side, there being a dot on each segment cephalad of the narrow light ring. Back of each black dot is a white one which encloses spiracle. First dorsal plate deep brown or blackish, a solid black band along the cephalic border which is extended caudad mesally, narrowly edged with pale. Vertex of head dark brown; clypeus and an area on each side embracing insertion of antenna and extending ventrad from it pale; eye patches and a triangular area between them and extending ventrad black, the median area including three light dots. Antennae blackish. Legs brown to yellow. Last plate like the first one, deep brown or blackish, narrowly edged with pale.

Head with a furrow-like depression between the two eyes, the fine median longitudinal line extending from this across the vertex.

Eye areas oval but with the inner ends obliquely truncate. Ocelli convex, arranged in eight transverse rows as follows, counting from above ventrad: 4, 8, 9, 9, 10, 11, 9, 5, making a total of 65, in the specimen described.

Antennae of medium length, slender.

Cervical plate large. A weak median longitudinal impression which is obsolete on anterior portion. Lower lateral portion impressed with a longer striation near and subparallel with margin and dorsad of this and extending from the caudal margin a second, short stria, one or two other similar ones sometimes indicated.

Other segments sharply striate beneath. Spiracles small, not touching the transverse suture which is sinuate at its level.

Anal scutum smooth. Distal portion triangular, the apex sharply angular, straight, not at all decurved.

Anal valves with the mesal margin elevated, setigerous.

Anal scale roughly triangular; each lateral side mesally convex; incurved adjacent to proximal and distal angles; cephalic margin widely convex.

Male: Gnathochilarium with stipes not produced mesally. The very large promentum obovate, a little crenately incised each side of the middle on distal margin and also proximad of each disto-lateral corner. Hypostoma free except laterally. See Pl. XL, fig. 6.

First legs of male strongly enlarged, uncinate. The inner surface tuberculate as usual, and bearing long bristles as shown in the figure.

Second legs of male reduced excepting for greatly enlarged coxae, as usual; the claws small. See Pl. XL, fig. 7.

Gonopods of male large and conspicuously exposed. The anterior pair with the mesal branches a little the longer, attenuated from the base distad but produced caudo-laterally near or a little below its middle height. Outer branch clavately enlarged distad, embracing the first on the antero-lateral surface; pilose with long hairs over the distal end and proximally along the disto-mesal face for part of the length.

Posterior gonopods with the outer distal branch somewhat clavate apically and densely pubescent with fine short hairs. Inner branch almost straight, blade-like, acutely pointed. From the inner edge of the outer branch springs a third, spine-like, process which extends distad between the two main ones. See Pl. XL, fig. 8, and Pl. XLI, figs. 1, 2, and 3.

Length of a male 55 mm. Width 3 mm. Length of antenna ad 3 mm. Number of segments 51–57.

Locality—Canyons of the Wahsatch Mountains, Utah.

The most common diplopod in Utah. It is evidently closely allied to P. furcifer, which it resembles much in general appearance and in the general type of gonopods in the male. The latter are readily to be distinguished, however, both from characters in the anterior pair and especially those of the pos-

terior pair which differ in ending in three processes instead of in two, a slender spinous process appearing between the two major ones which are alone present in P. furcifer, etc.

Paraiulus furcifer Harger **var. sinampus**, new.

A row of small dark, inconspicuous dots along each side toward dorsum, the dorsum above and between the two rows of dots light yellowish brown, the sides below the dots distinctly darker, brown; each segment with a dark blackish brown to black annulus which is broadest across dorsum and narrows ventrad down each side; a narrower and rather less deeply colored dark line along junctions of adjacent segments which below disappears in the brown of the sides. A fine median dorsal dark line, on each side of which on each segment is a yellowish white line which does not extend laterad as far as the line of dark dots. First dorsal plate dark brown or chestnut, especially the caudal border pale. Penult and antepenult segments and the proximal portion of anal scutum pale. Venter pale. Legs medium brown. Vertex of head black, the dark area extending ventrad between the antennae; clypeal and lateral regions of head pale. Antennae black or blackish.

Body in the not fully adult male being described somewhat constricted caudad of head, the first segment narrower than the second and subsequent ones.

First segment moderate; the lateral margins running obliquely from caudal edge of head ventro-caudad to junction with posterior margin which curves forward to angle. Lower lateral portion of plates marked with two distinct striae which extend forward a short distance from the caudal margin, in addition to the line margining the lateral edge. Caudal border not margined, the anterior one obscurely so.

Second segment with the lower lateral border extended ventrad mesally in an acute angle of which the cephalic side is much the longer. Deeply striate beneath, above somewhat roughened, as on subsequent segments.

Spiracles more or less elongate longitudinally, moderate, separated from the transverse suture which is somewhat weakly quadrately emarginate opposite them.

Anal plate not roughened. Distal portion subtriangular, straight, apically somewhat rounded. Extending a little beyond the anal valves.

Anal valves with mesal edges narrowly margined, not elevate. Each valve with a longitudinal impression ectad of its middle.

Anal scale subtriangular, the caudal angle acute, not at all rounded.

Legs rather long. Dorsally glabrous. Inner surface with longitudinal series of stout, spinescent setae.

Head roughened with areolations formed by a network of impressed lines. A bow-shaped line impressed between inner angles of the two eye areas, the line angularly bent dorsad at middle where it is joined by the median longitudinal line of the vertex. A wide, shallow, median depression from frontal region to clypeus which is deepest ventrad. Head furrowed below eye area on each side from base of antenna toward gena and then dorsad along the border of the head.

Eye area large, subtriangular, the dorso-mesal and ventro-lateral sides convex and the ventro-mesal nearly straight. Ocelli arranged in eight straight transverse rows which, counting from above ventrad, are as follows: 8, 10, 9, 8, 7, 6, 5, 3, making a total of 56.

Antennae slender, a little enlarged distally, the sixth article thickest. Clothed with short hairs intermixed with longer ones, the hair more dense distally.

First legs of male thickened, but as yet straight and not distally hamate. Coxae fused in middle line. See Pl. XLI, fig. 8, and Pl. XLII, fig. 2.

Second legs not as yet reduced, as large as the third but the four distal articles forming a hook which seems firm and is directed cephalad. Claw large.

Lower margin of seventh segment but slightly angularly extended. Gonopods enclosed in a single sheath, the body being very long and presenting indications of the separate pieces only distally. See Pl. XLI, figs. 5 and 6. Upon removal of the envelope the copulatory organs are revealed in their usual character and relations, but the posterior pair not yet engaged distally with the inner branches of the anterior pair as in the adult furcifer, its two prongs being straight and closely appressed together and the outer one distally pilose. Outer branch of anterior pair provided with long hairs as in the adult furcifer.

Number of segments 58.

Locality—Portland, Oregon (1902).

The description above is of a male which as indicated previously, is not wholly mature, although apparently or probably within one moult of being so. While the copulatory organs when released from the peculiar sheath are seen to be fully formed and in most respects in close agreement with those of typical furcifer, the coloration is markedly different from that usually found in P. furcifer of the corresponding age. Furthermore, an adult female collected at the same time has precisely the same coloration and differs from furcifer. It has seemed best to designate the form for the present at least, therefore, as a distinct variety. Because of the interesting points presented the young male is described in full and illustrations of a number of its features presented.

FAMILY PAEROMOPIDAE.

Paeromopus lysiopetalinus Karsch.

Figures of this interesting form, so long obscure as to its affinities because of incompleteness of the original description and lack of specimens in collections, are presented in Plate XLII, figs. 3 to 5, and in Plate XLIII, figs. 1 to 3. The author has specimens of this form from Portland, Oregon, and from Pacific Grove and Stanford, California.

FAMILY CAMBALIDAE.

Paiteya, gen. nov.

Eyes fairly well developed, consisting of a moderate number of ocelli arranged in two or more rarely in three transverse series.

Antennae short, a little clavately thickened distad. Second article longest, the sixth next; the others much shorter, the third, fourth and fifth not much differing in length. The four sensory cones slender and moderately long.

Gnathochilarium narrowest proximally. Promentum elongate, triangular completely separating the laminae linguales which are strongly narrowed proximad.

Body iulus-like in general form. All segments striate beneath; dorsum of segments from the fourth to the antepenult, not inclusive, each with a series of strongly developed keels of which the most ventrad on each side is thickened and bears on the enlarged caudal portion of edge the spiracle.

Legs definitely armed with spiniscent bristles.

First legs of male reduced; with six articles; normally armed.

Second legs of male likewise reduced but otherwise normal in structure.

Type—*Paiteya errans* sp. nov.

Distribution—Southern California.

Paiteya errans sp. nov.

Brown in transverse encircling bands which, except on anterior segments, alternate with paler yellow bands which are broadest on dorsal surface and increase in extent on posterior segments; fifteen or so of the segments immediately following the fourth with an oval pale spot enclosed in the dark band laterally, these spots on posterior segments becoming confluent on the caudal side with the yellow of the adjacent yellow stripe; first four segments usually unmarked laterally with any such pale spots. A row of black spots on each side in line with the spiracles and extending caudad as far as the antepenult segment, not inclusive; these dark spots sharply defined excepting on the most anterior segments where they tend to be more diffuse and commonly enclose a paler area. First four segments commonly with a pale transverse band on dorsum, this band narrow at mesal line and expanded laterally, commonly areolated with dark. All dorsal carinae dark along their edges. Anal scutum brown excepting the caudal portion. Venter, legs and antennae yellow. Vertex crossed by a transverse yellow band which expands about the black eye area on each side. Between eye and antenna of each side and those of the opposite is a broad brown area which is often areolated with pale. Head below this latter dark band yellow.

Body constricted caudad of head, most strongly so over from about fourth to ninth segments.

Eyes in adults with ocelli in two rows which run a little oblique to the lateral portion of front margin of the first segment, which covers several of the more caudal ocelli. Ocelli commonly about nine arranged with the greater number in the dorsal series, thus: 6, 3; occasionally a single eye in a third row. Eye area extending almost transversely.

Antennae short. A little clavately thickened. The second and sixth articles longest; others distinctly longer than broad. Proximal articles sparsely provided with hairs of moderate length, especially toward the distal ends, the distal articles more densely clothed.

Gnathochilarium conspicuously broader distally than proximally. Lingual lamellae completely separated by the long, triangular promentum. Laminae strongly narrowed proximally, 2.75 times as long as the greatest width. Mentum toward proximal border with a sharply outlined semi-circular impression which has its concavity distad; wider at base than the median length in the ratio 11:9. Stipites nearly 3.5 times as long as the greatest width, the processes being included. In one specimen the processes of stipes were apparently completely fused together as shown in Pl. XLIII, fig. 4.

First segment nearly as long dorsally as the second and third taken together. Extending over the caudal portion of head. Posterior margin straight. Lateral margins widely rounded from caudo-lateral angles cephalo-mesad. The cephalic margin substraight mesally. Within each lateral margin several longitudinal striae extend cephalad from the caudal margin a mostly short distance.

Second segment with deep striae below, the striae on subsequent segments extending farther dorsad, on all but the most anterior and the most posterior reaching the lateral carina which is borne on all but the first segments. Spiracles beginning on the fifth segment. Dorsum of segments from the fourth to the antepenult (not inclusive) each with six strongly developed carinae, of which the lowermost on each side is conspicuously thickened. A weak, fine median keel along dorsum.

Anal scutum large, smooth, caudally rounded.

Anal valves exceeding the anal plate, the free margin thickened.

Legs without true hairs; but armed with definitely arranged spines or spinescent bristles. Claws very large, each armed with a well-developed spine springing from its base on the ventral side.

In the male the first two pairs of legs are reduced, but otherwise unmodified, having six articles and being normally armed.

Gonopods of male concealed excepting for the distal end of slender curved process which projects caudad on each side from beneath a covering plate.

Number of segments 47-49.

Length 19 mm. Width 1.4 mm.

Locality—Southern California.

EXPLANATION OF PLATES.

PLATE XXX.

Lysiopetalum mutans sp. nov.

FIG. 1. Gnathochilarium. X 70.
FIG. 2. Antenna. X 70.
FIG. 3. Eye. X 70.
FIG. 4. "Ovipositor", lateral aspect. X 39.5.
FIG. 5. The same, cephalic aspect. X 39.5.
FIG. 6. First legs, caudal aspect. X 47.
FIG. 7. Second legs, cephalic aspect. X 39.5.
FIG. 8. Third legs, caudal aspect. X 39.5.
FIG. 9. Fourth legs, caudal aspect. X 39.5.
FIG. 10. Fifth legs. X 39.5.

PLATE XXXI.

Lysiopetalum mutans sp. nov. (cont.)

FIG. 1. Ninth leg, caudal aspect. X 39.5.
FIG. 2. Thirteenth leg, caudal aspect. X 39.5.

Conotyla deseretae sp. nov.

FIG. 3. First legs of male.
FIG. 4. Gonopods of male, caudal aspect.
FIG. 5. Gonopods of male, cephalic aspect.
FIG. 6. Gonopods of male, lateral aspect.
FIG. 7. Eighth legs.
FIG. 8. Antenna.

PLATE XXXII.

Conotyla deseretae sp. nov. (cont.)

FIG. 1. Second legs.
FIG. 2. Third legs.
FIG. 3. Fourth legs.
FIG. 4. Fifth legs.
FIG. 5. Sixth legs.
FIG. 6. Seventh legs.
FIG. 7. Gnathochilarium.

Conotyla coloradensis sp. nov.

FIG. 8. Appendages of second segment of the female.
FIG. 9. Eye.

PLATE XXXIII.

Conotyla coloradensis (cont.)

FIG. 1. Gnathochilarium. X 39.5.
FIG. 2. Antenna. X 87.
FIG. 3. Seventh article of antenna, more highly magnified.

Tingupa utahensis gen. et sp. nov.

FIG. 4. Antenna. X 70.
FIG. 5. Eye. X 87.
FIG. 6. Eye of an immature specimen. X 87.
FIG. 7. Female appendages of the second segment.
FIG. 8. First legs of female. X 70.

PLATE XXXIV.

Tingupa utahensis gen. et sp. nov. (cont.)

FIG. 1. Gnathochilarium. X 87.
FIG. 2. Caudal end of body, dorsal view. X 47.

Tingupa monterea gen. et sp. nov.

FIG. 3. Eye. X 87.
FIG. 4. Antenna. X 87.
FIG. 5. Gnathochilarium. X 70.

Caseya irritans sp. nov.

FIG. 6. Eye. X 87.
FIG. 7. Head and first six segments, lateral aspect.
FIG. 8. Caudal end of body, dorsal view. X 18.5.
FIG. 9. Antenna. X 33.

PLATE XXXV.

Caseya irritans sp. nov. (cont.)

FIG. 1. Gnathochilarium. X 70.

Striaria nasinta sp. nov.

FIG. 2. Antenna. X 70.
FIG. 3. First legs. X 47.
FIG. 4. Gnathochilarium, basal sclerites not shown. X 87.
FIG. 5. Labrum. X 70.
FIG. 6. First segment, caudal aspect. X 39.5.

Fontaria tuobita sp. nov.

FIG. 7. Gonopods, cephalic aspect. X 47.
FIG. 8. Gonopods, caudo-ventral aspect. X 47.

PLATE XXXVI.

Scytonotus piger sp. nov.

FIG. 1. First segment in outline from dorsal aspect. X 33.
FIG. 2. Carina of fourth segment from the ultimate. X 70.
FIG. 3. Carina of fifth segment from the ultimate. X 70.
FIG. 4. Gnathochilarium (proximal portion not shown). X 47.
FIG. 5. Antenna (proximal article not represented). X 39.5.

Polydesmus (*Kepolydesmus* subgen. nov.) *anderisus* sp. nov.

FIG. 6. Antenna.
FIG. 7. First leg of male. X 22.
FIG. 8. Second legs of male. X 22.
FIG. 9. Head and first segment in outline, dorsal aspect. X 22.

PLATE XXXVII.

Polydesmus (*Kepolydesmus* subgen. nov.) *anderisus* sp. nov.

FIG. 1. Third legs of male, caudal aspect. X 22.
FIG. 2. Gonopods of male, caudal aspect. X 33.
FIG. 3. Gonopods of male, cephalic aspect. X 33.
FIG. 4. Gonopods of male, lateral aspect. X 33.

Polydesmus (*Kepolydesmus*) *sontus* sp. nov.

FIG. 5. Antenna. X 33.
FIG. 6. First segment in outline, dorsal aspect. X 22.
FIG. 7. First legs, caudal aspect. X 33.

PLATE XXXVIII.

Polydesmus (*Kepolydesmus*) *sontus* sp. nov. (cont.)

FIG. 1. Fifth legs, caudal aspect. X 33.
FIG. 2. Gonopods of male, caudo-ventral aspect. X 47.
FIG. 3. Gonopods of male, lateral aspect. X 47.

Polydesmus amandus sp. nov.

FIG. 4. Antenna. X 33.
FIG. 5. Head and first two segments in outline, dorsal aspect. X 33.
FIG. 6. Gonopods of male, lateral aspect. X 70.

PLATE XXXIX.

Polydesmus amandus sp. nov. (cont.)

FIG. 1. Gonopods of male, cephalo-ventral aspect. X 47.

Polydesmus sastianus sp. nov.

FIG. 2. Head and first two segments in outline, dorsal aspect. X 33.
FIG. 3. Antenna. X 44.

Polydesmus socarnius sp. nov.

FIG. 4. Head and first two segments in outline, dorsal aspect. X 39.5.
FIG. 5. Antenna. X 33.

Paraiulus zakiwanus sp. nov.

FIG. 6. Posterior gonopods of male, lateral aspect. X 33.
FIG. 7. Posterior gonopods of male, cephalo-dorsal aspect. X 33.

PLATE XL.

Paraiulus zakiwanus sp. nov. (cont.)

FIG. 1. Anterior gonopods of male, cephalic aspect. X 33.
FIG. 2. Anterior gonopods of male, caudal aspect. X 33.
FIG. 3. Anterior gonopods of male, lateral aspect. X 33.
FIG. 4. First legs of male, cephalic aspect. X 18.5.
FIG. 5. Second legs of male, caudal aspect. X 33.

Paraiulus tiganus sp. nov.

FIG. 6. First legs of male, cephalic aspect. X 18.5.
FIG. 7. Second legs of male, caudal aspect. X 33.
FIG. 8. Posterior gonopods of male. X 22.

PLATE XLI.

Paraiulus tiganus sp. nov. (cont.)

FIG. 1. Anterior gonopods of male, cephalic aspect. X 18.5.
FIG. 2. Anterior gonopods of male, caudal aspect. X 18.5.
FIG. 3. Anterior gonopods of male, lateral aspect. X 18.5.
FIG. 4. Gnathochilarium of male. X 22.

Paraiulus furcifer sinampus var. nov.

FIG. 5. Distal portion of sheath of gonopods in immature male, cephalic aspect. X 33.
FIG. 6. The same, lateral aspect. X 33.
FIG. 7. Gnathochilarium of same specimen.
FIG. 8. First and second legs of same specimen, lateral aspect. X 33.

PLATE XLII.

Paraiulus furcifer sinampus var. nov. (cont.)

FIG. 1. Labrum. X 70.
FIG. 2. First legs of same specimen, caudo-ventral aspect. X 33.

Paeromopus lysiopetalinus Karsch.

FIG. 3. First legs of male, caudal aspect. X 18.5.
FIG. 4. Posterior gonopods of male, cephalic aspect. X 18.5.
FIG. 5. Anterior gonopods of male, cephalic aspect. X 18.5.

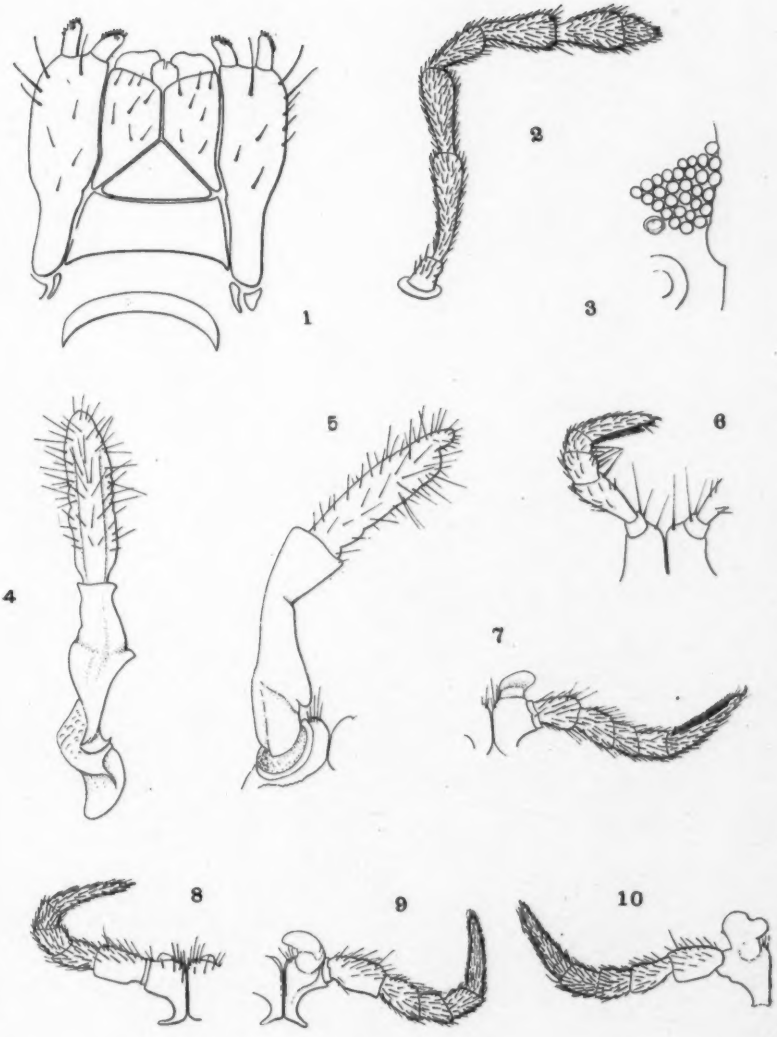
PLATE XLIII.

Paeromopus lysiopetalinus Karsch (cont.)

FIG. 1. Gnathochilarium. X 18.5.
FIG. 2. Antenna. X 18.5.
FIG. 3. Second legs of male, showing penial process. X 18.5.

Paiteya errans gen. et sp. nov.

FIG. 4. Gnathochilarium. X 70.
FIG. 5. Eye. X 87.
FIG. 6. First legs of male, cephalic aspect. X 70.
FIG. 7. Antenna. X 47.



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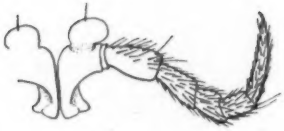

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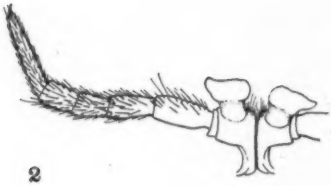

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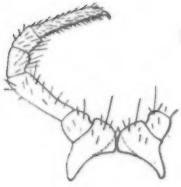

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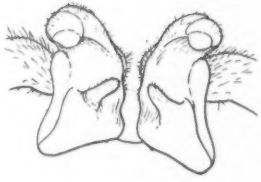

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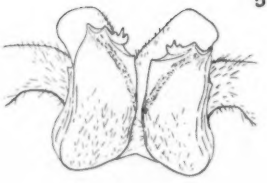

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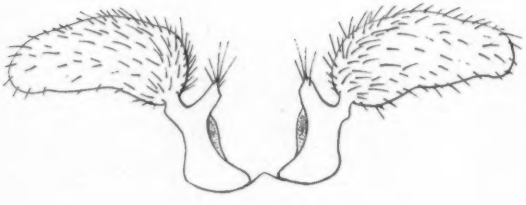

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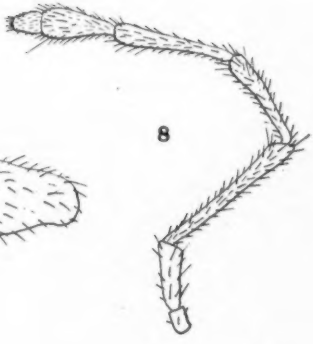

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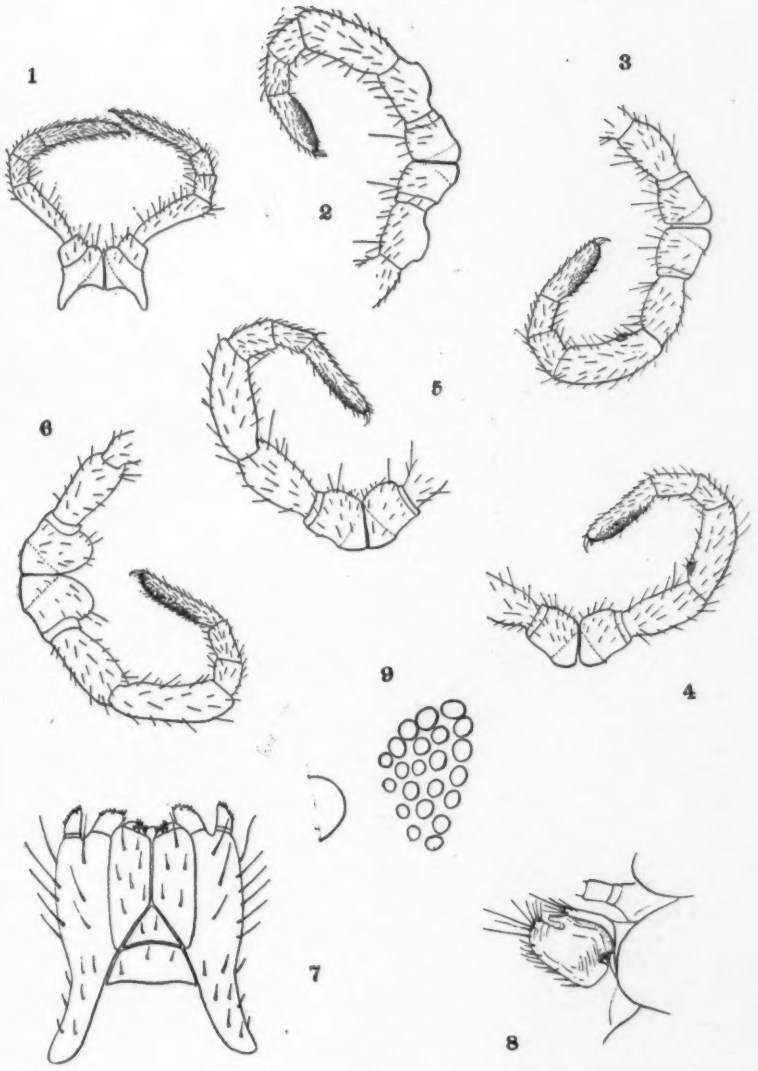

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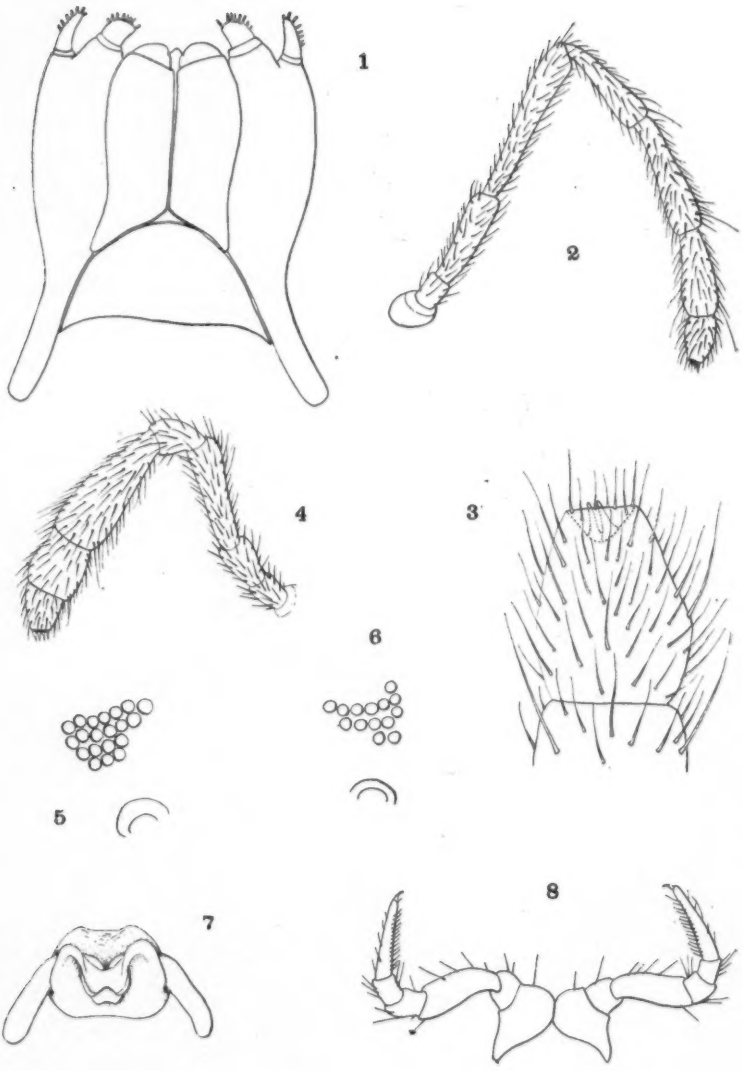

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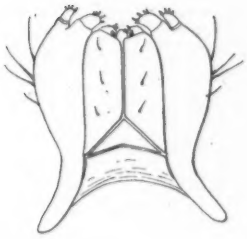

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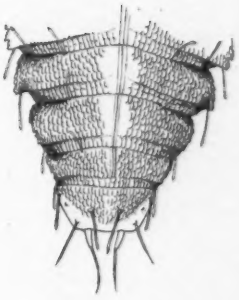

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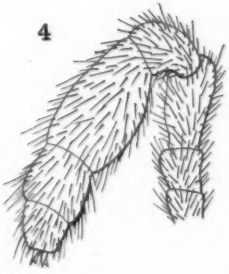

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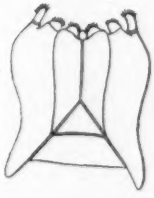

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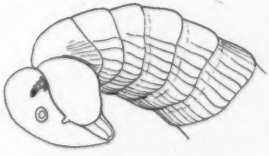

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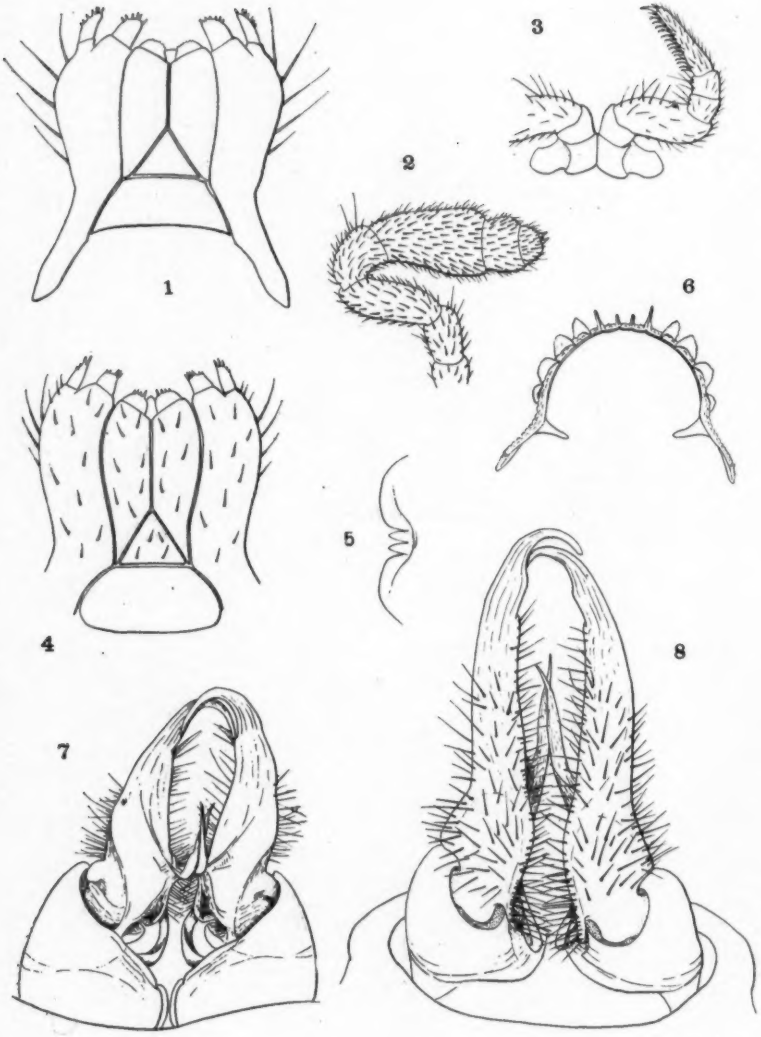

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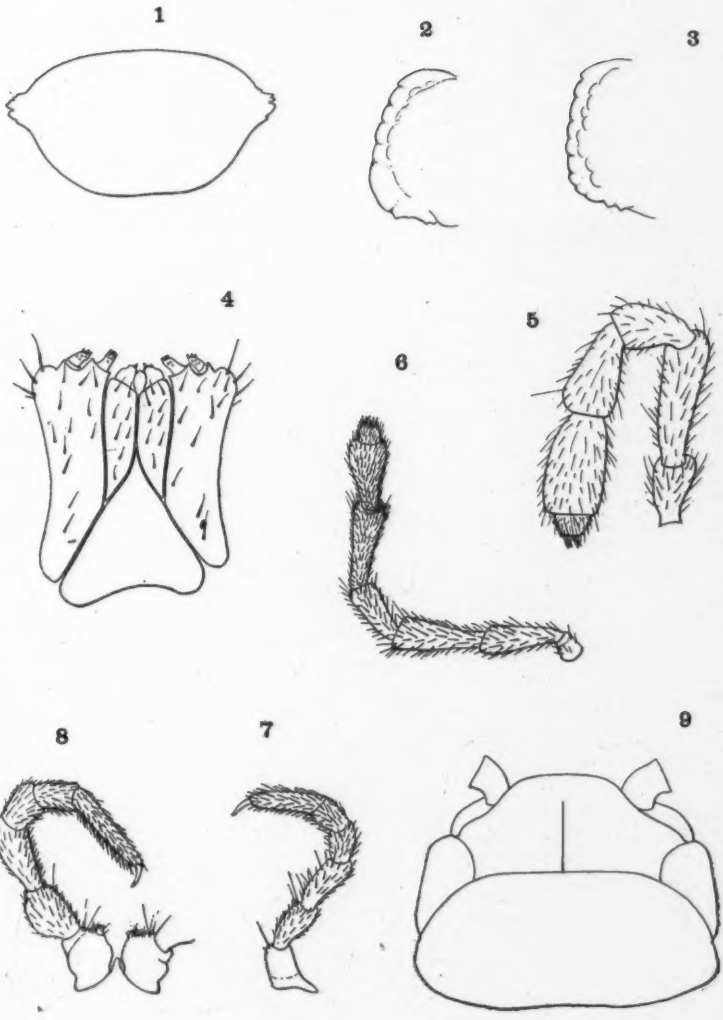

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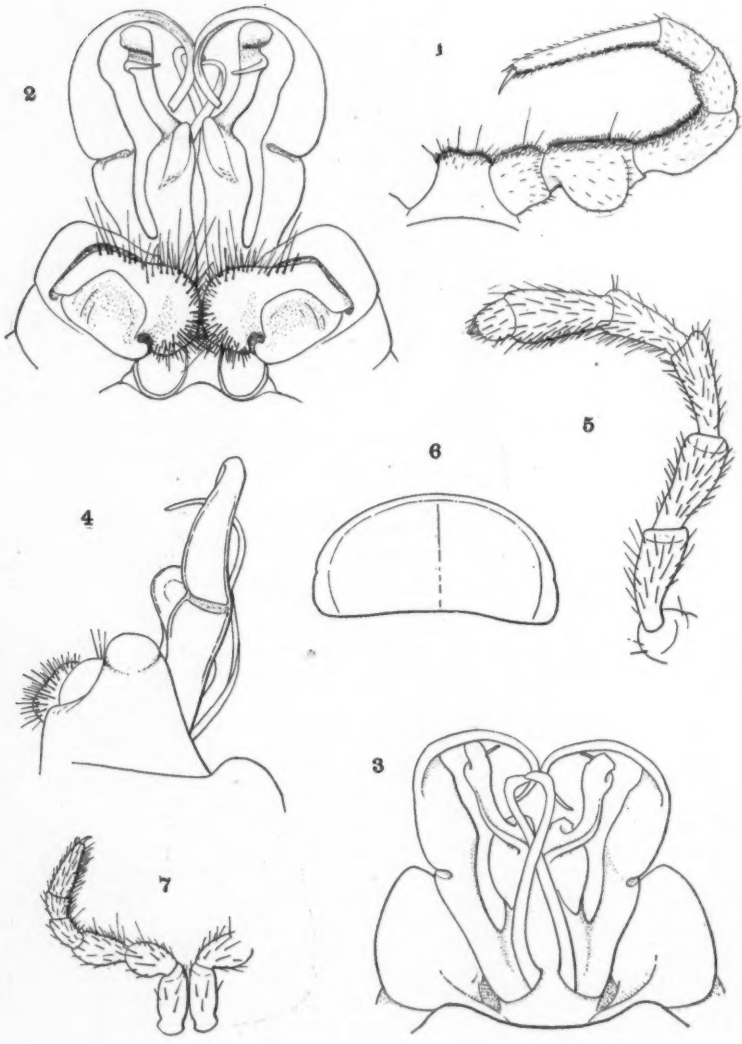

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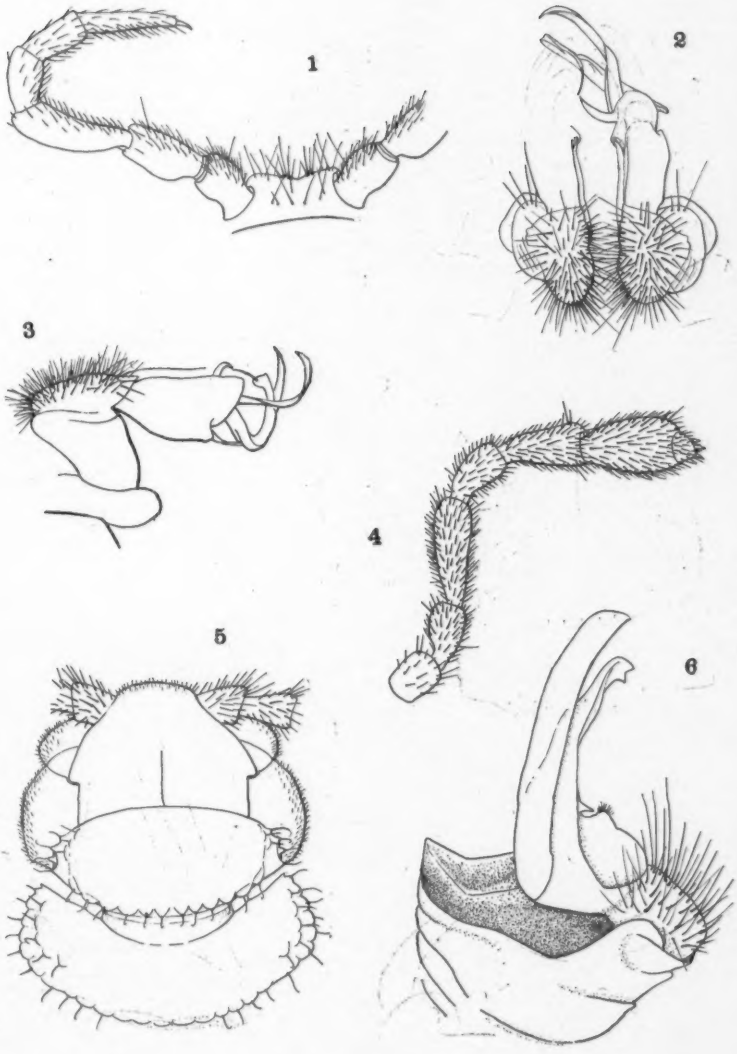

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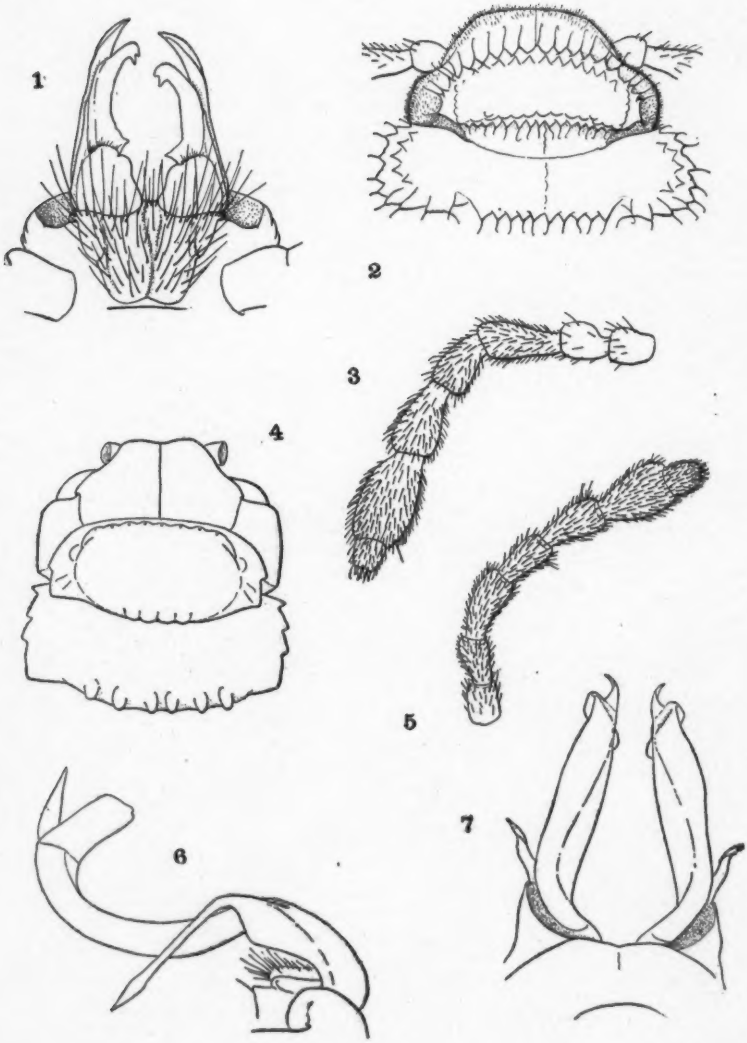

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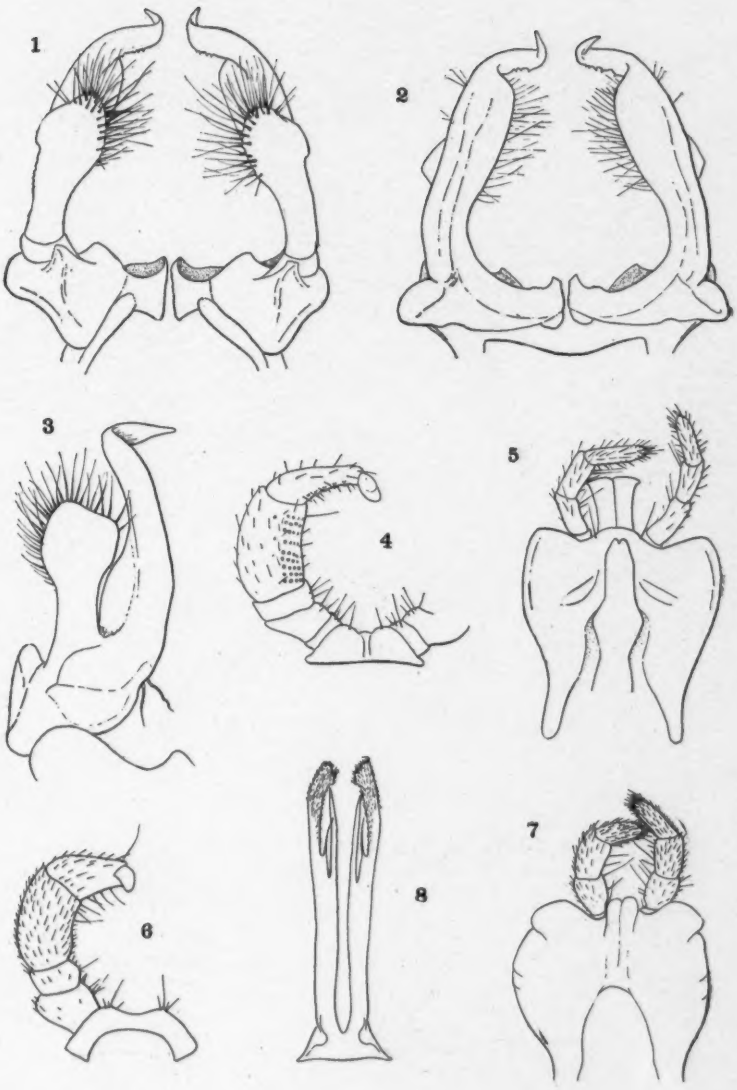

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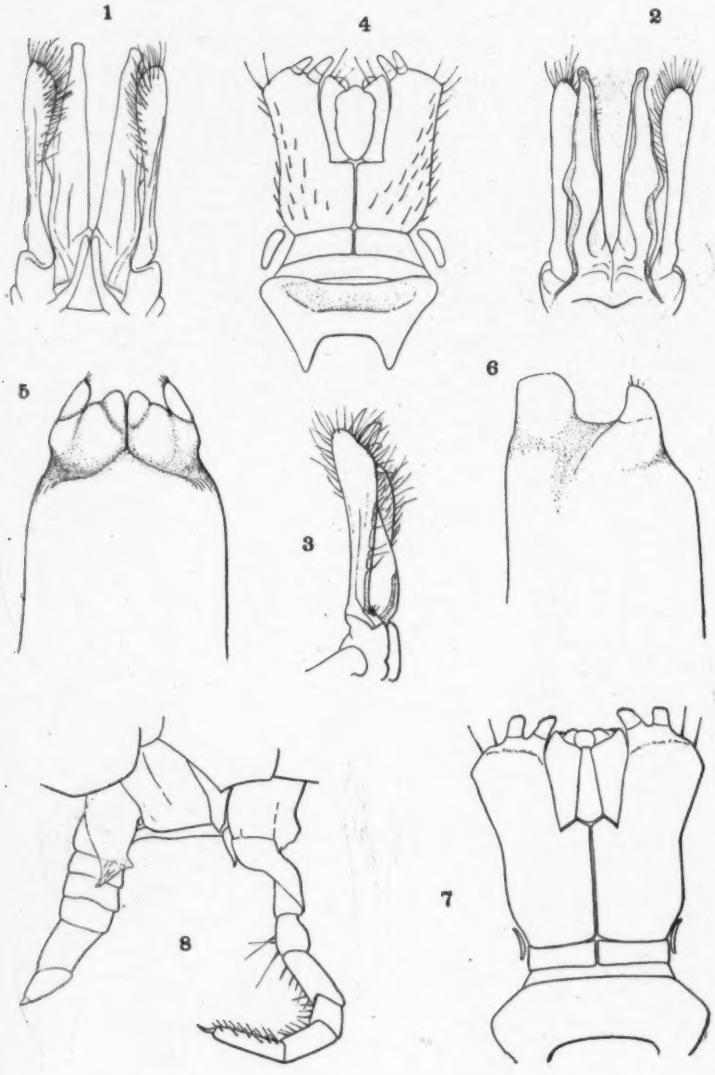

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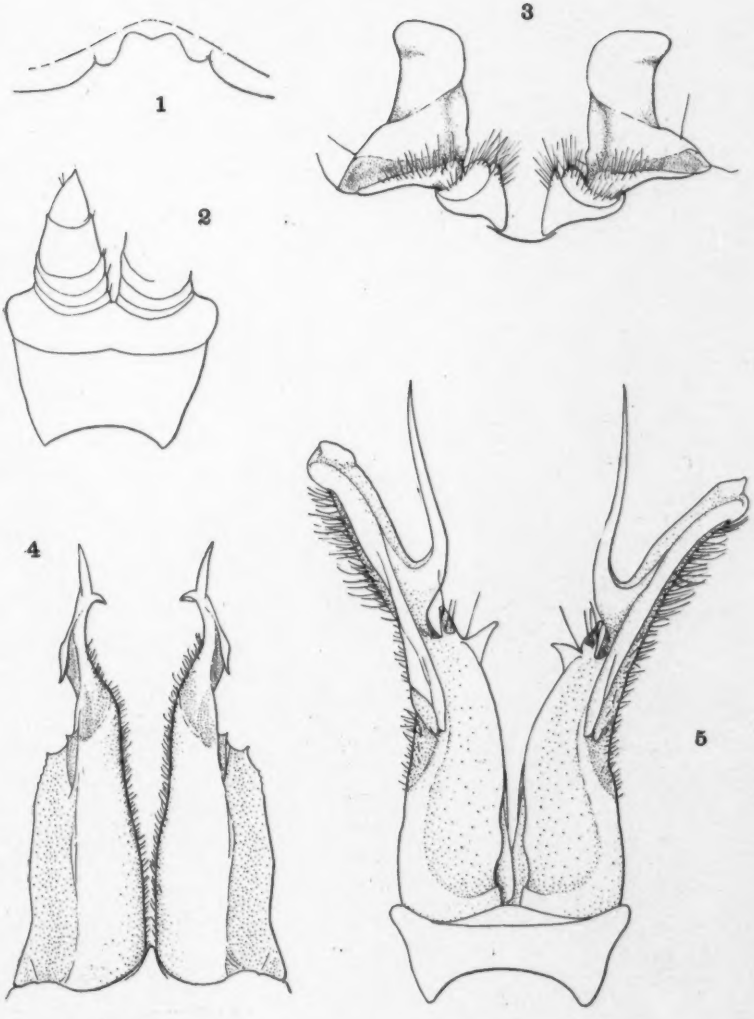

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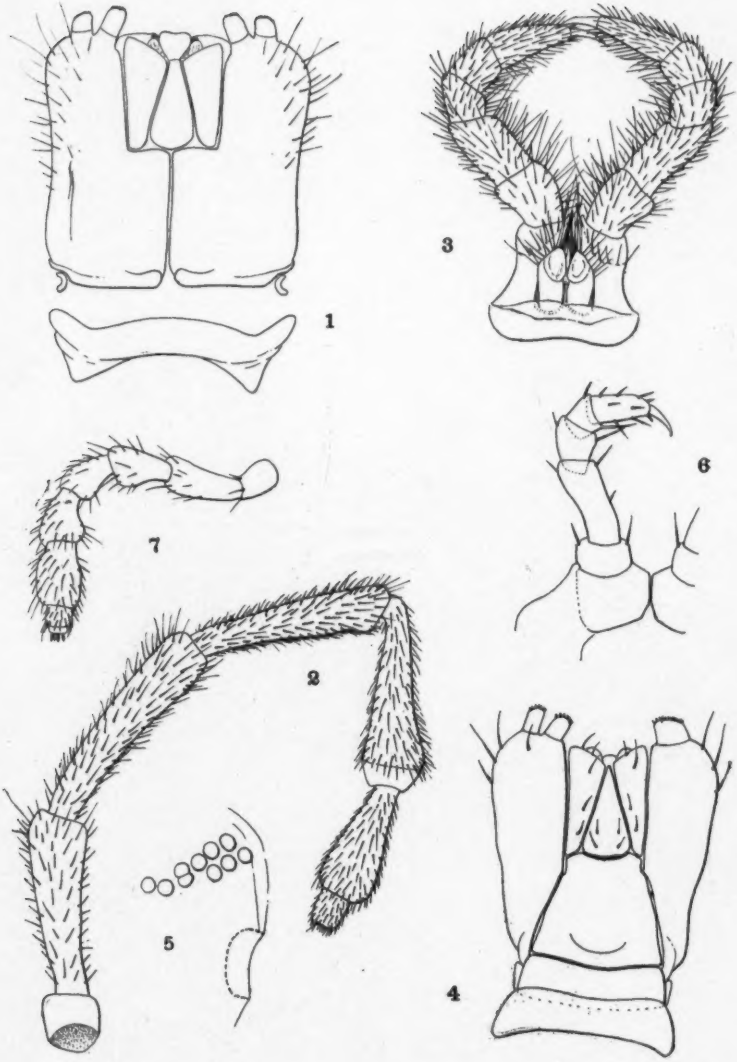

Ralph V. Chamberlin.

THE STRUCTURE AND METAMORPHOSIS OF THE ALIMENTARY CANAL OF THE LARVA OF PSYCHODA ALTERNATA SAY.*

By LEONARD HASEMAN.

The changes which take place in the digestive epithelium of insects after feeding, and in connection with the molting periods, have been but little studied, though in the cases known the phenomena are of great interest. In some insects partial, in others, total regeneration of the mid-intestinal epithelium has been found to occur after each taking of food. In other instances it is the changes associated with molting which have attracted attention. It was with a view of studying the morphological changes in the epithelium at the two periods and of correlating the results with those of previous workers that this study of the larva of Psychoda alternata was undertaken.

A review of the literature shows that but little has been done along these lines with larval forms. Aside from the work of Van Gehuchten ('90 and '93) on Ptychoptera contaminata, Mobüsz ('97) on Anthrenus and Folsom and Wells ('06) on Collembola, we find only scattered references here and there in more general papers on the digestive system. Psychoda alternata has been selected for the present work because of the ease with which it can be secured and bred throughout the year, its wide distribution, its convenient size for work and the fact that it is one of the most generalized Diptera.

This study was carried out in the Entomological Laboratories of Cornell University, and to Professor J. H. Comstock, I am greatly indebted for valuable suggestions and criticisms. The subject was suggested and the work done under the immediate supervision of Dr. W. A. Riley, to whom I am especially obligated for constant advice and help.

THE STRUCTURE OF THE ALIMENTARY CANAL.

The alimentary canal of the larva of Psychoda alternata is a straight tube extending from the mouth to the anus, without folds, except during bodily contraction when a slight one is formed in the region of the small intestine. Aside from the attachment of strong pharyngeal muscles and the Malpighian

*Contribution from the Entomological Laboratories of Cornell University.

vessels, the surface of the canal for its whole length is unbroken (Fig. 1). From the exterior the division into fore-, mid- and hind-intestine is distinctly marked. The short, much constricted fore-intestine extends back to the third thoracic ganglion. Here, by means of a strong esophageal valve, it connects with the very large mid-intestine, which in turn extends back to the sixth abdominal segment, where the somewhat constricted hind-intestine begins.

The opening of the mouth is on the ventral surface of the anterior part of the head. The clypeus and recurved labrum form a rostrum over and in front of it. The labrum bears, on either side of its anterior recurved margin, a fan of bristling hairs (Fig.3 lr.) The area between these fans is armed with numerous posteriorly directed, strong setae and minute serrate chitinous plates. Posterior to this area is a strong V-shaped plate and laterad of it, along the margin, a pair of mesally directed triangular plates. Behind the V-shaped plate comes a group of small chitinous plates, arranged in a circle, and a series of minute setae. A pair of small plates, bearing numerous minute teeth on their mesal margins, lies laterad of this chitinous ring. Farther back is a pair of lateral tufts of setae and a second pair of oval plates.

The mandibles are strongly chitinized with numerous lateral setae, a single strong spine, with numerous minute teeth on its inner margin, and two long plumes (Fig. 3, md.) On the inner margin are two series of strong teeth, directed at an angle to each other, and a single posterior thumb-like tooth directed cephalad. The hind margin of the mandible is deeply concave to receive the anterior part of the maxilla.

The maxillae are but slightly chitinized, with four short stout teeth on their inner margin, a small median plume and a fan of long setae extending the full length of the lateral margin. The palpi are short and thick with six small papillae and numerous short setae. They are circular in outline and fit into the depressions in the hind margins of the mandibles (Fig. 3, mx.)

The labium is a fleshy lobe bearing numerous fine setae and papillae. On the anterior margin are two small tufts of short setae and behind these a crescent-shaped chitinous plate (Fig. 3, la). The sense papillae found upon the labrum, maxillae, palpi and labium are so placed as to come in contact with the food as it enters the mouth and therefore are very probably organs

of taste. The setae and plumes surrounding the mouth are curved, near their tips, and so arranged as to sweep food into it when the mouth parts are in motion.

The mouth opens almost immediately into the pharynx, which is somewhat expanded dorsally and supported on its cephalo-lateral margins by curving chitinous bars (Fig. 4, ph.) Strong muscles extend from its cephalic, lateral and dorsal surfaces to their points of attachment on the chitinous surface of the head. Posteriorly the pharynx tapers rapidly into the narrow esophagus so that their point of union is hardly discernable. The esophagus is slender, uniform in diameter and extends from the subesophageal ganglion to a point opposite the third thoracic ganglion. The surface of the esophagus is free from any visible suspensory attachments and, to the unaided eye, shows rather indistinctly the arrangement of the circular muscles.

Lying alongside the esophagus, above the first thoracic ganglion, are the salivary glands. They are quite prominent, each about the size of one lobe of the brain, and strongly reniform. From the ventral end of each gland, a minute duct extends downward and forward to a point below the subesophageal ganglion, where the two from opposite sides unite to form the main salivary duct. This duct runs forward below the alimentary canal to the mouth, where, as we shall see later, it opens between the hypopharynx and labium (Fig. 4, d.)

Closely enclosing the pharynx are the commissures connecting the brain with the subesophageal ganglion (Fig. 4, com.) These commissures extend forward and slightly downward on either side until the level of the pharynx is reached when each turns rather abruptly backward and downward to the subespohageal ganglion.

Above the second and third thoracic ganglia, the narrow esophagus is telescoped into the mid-intestine forming the espohageal valve. The diameter of the tube in the region of the valve is much greater than that of the esophagus but less than that of the mid-intestine farther back (Fig. 1, es. v.) The mid-intestine normally is a smooth tube tapering slightly anteriorly from its middle and posteriorly from a point near its union with the hind-intestine. When it is gorged with food, however, its diameter may be more uniform throughout. In surface view the cellular structure of the mid-intestine stands out very distinctly even with low power magnification.

The alimentary canal and especially the mid-intestine is closely and firmly enclosed in columns of adipose tissue. Four longitudinal lateral strands extend the full length of the larva with shorter strands here and there. The adipose tissue and Malpighian vessels form a perfect cushion about the canal and in this way support it in the central part of the body cavity. When the alimentary canal is dissected out the adipose tissue adheres to it and severs its connection with the body wall, and the respiratory and nervous systems. In living larvae numerous fine tracheal branches, from the pair of dorsal longitudinal tracheae, are seen to ramify the fat bodies and send finer branches to the alimentary canal. The nervous connections with the adipose tissue and alimentary canal are much finer and more difficult to discern than are the tracheal connections. Delicate cephalad directed fibers from the large dorsal nerve, which extends caudad from the eighth abdominal ganglion, are seen to attach to the ileum just behind the Malpighian vessels corresponding to suspensory nerves described by Comstock and Kellogg, '95, for Corydalis. These fine nervous connections from below with the tracheal connections from above assist in supporting the alimentary canal.

From surface view the hind intestine is distinctly divided into ileum and colon, while the rectum is less easily made out (Fig. 1). The ileum extends from the point of attachment of the Malpighian vessels, opposite the anterior end of the sixth abdominal segment, to the middle of the seventh segment where it joins the much expanded colon. It is so much narrower than the mid-intestine on the one hand and the colon on the other that, in surface view, it stands out in sharp contrast with them. The circular muscles of the ileum are strongly developed and appear as a distinct transverse surface banding. The walls are very thin and elastic.

The diameter of the anterior end of the colon is twice that of the ileum, while posteriorly it tapers to the rectum where it is about equal that of the ileum. The walls of the colon are very thick and but slightly elastic. The circular muscles are strongly developed and are imbedded in pits in the epithelium.

The rectum is quite short, extending from a point opposite the anterior end of the eighth abdominal segment, where the canal bends ventrad, to the anus. It is narrower than the colon and the circular muscles are not imbedded in pits. Exteriorly

it is developed into four distinct papillae which surround the anus (Fig. 1, a. p.)

The Malpighian vessels join the alimentary canal at the union of the mid-intestine and ileum. They are five in number, two on the latero-ventral side, two on the dorso-lateral side, and the fifth on the dorsal surface of the canal (Fig. 1, m. t.) The vessels all have an expanded reservoir-like basal portion, which in living larvae is snow-white, but in alcoholic specimens fades out (Fig. 27, c.) The two latero-ventral vessels extend far forward to a point opposite the middle of the mid-intestine where they make an abrupt turn backward for a short distance. The two dorso-lateral ones start forward but in the middle of their expanded basal reservoirs they turn abruptly upon themselves and their distal ends become closely associated with the reproductive organs opposite the middle of the colon. The dorsal tubule follows the same course, its tip lying free above the middle of the colon. Beyond the expanded basal reservoir, the vessels are much constricted and heavily charged with a reddish-brown pigment in life. The vessels are slightly motile.

Wheeler ('93) claims that the primitive number of Malpighian vessels in insects is six. Where there are less than six, he claims that the reduction is due to a loss or fusion of certain ones, while where there are more than six, he explains it as being due to a division of some of them. However this may be, it is well known that the vessels are usually paired, that is, there is an even number of them. It is rare to find an odd number of Malpighian vessels in insects. Wheeler reports seven for a Neuropterous larva, probably Chauliodes, and the same number is found in the larva of Corydalis cornuta. Five Malpighian vessels have been found in Culex and Psychoda. I find this same number in Pericoma. In Psychoda alternata there seems to be no difference in form or structure between the single dorsal vessel and the other four paired vessels. They all join the alimentary canal singly and are about equi-distant. The same number and arrangement are found in the pupal and adult stages.

Surrounding the anal opening are four prominent fleshy lobes. These are direct prolongations from the rectum and have a respiratory function. Numerous fine tracheae extend downward and forward to these, from a constriction in the large longitudinal tracheae just caudad of the vent. These lobes are

slightly protractil, becoming especially prominent in larvae that have been submerged for a considerable length of time. They are homologous with the anal tracheal gills of other insects. Vaney ('02) gives a figure showing the connection of the tracheae with these lobes in a Psychoda larva where the tracheae are far more prominent than in Psychoda alternata.

The chitinous intima of the mouth cavity is quite thick and continuous with that of the mouth parts and surface chitin of the head (Fig. 5, in.) The epithelium is thin except beneath the minute serrate plates on the anterior surface of the labrum where the cells are very long and slender. In longitudinal sections the hypopharynx and epipharynx are very prominent. The epipharynx is closely associated with the back part of the labrum and bears setae and taste papillae (Fig. 5, eph.) The hypopharynx lies immediately above the labium. Its intima is very thick and dark and near its base are strong setae protruding into the mouth of the pharynx (Fig. 5, hy.)

From the back part of the mouth the food passes directly into a large chamber, the anterior part of the pharynx (Fig. 2, ph.) The dorso-cephalic wall of this chamber is very thin and flexible to accommodate varying quantities of food. On either side of this chamber near its anterior end are two strong dorsally directed curving chitinous bars. These bars from opposite sides almost meet above and below and serve as a support for the flexible walls and at the same time bear a series of long yellow ventro-mesally directed chitinous setae which give them a comb-like appearance (Fig. 6, ph. b.) These comb-like structures across the entrance to the alimentary canal function as strainers in keeping out large foreign bodies. The pharyngeal chamber is always more or less filled with food and probably functions as a crop in which the food is mixed with the salivary secretions, by the action of the circular and pharyngeal muscles and these comb-like chitinous structures. The epithelium in this part of the pharynx is quite thin, while the chitinous intima is thick. The circular muscles in this region are by no means so strongly developed as in the caudal part of the pharynx.

The posterior portion of the pharynx is constricted so that its diameter is about equal that of the esophagus. In transverse section it appears pear-shaped, the broader portion being ventrad (Fig. 9.) It is provided with very powerful circular muscles which lie so closely together as to form almost a continuous

layer. The epithelium consists of very large cells, with large oval nuclei, whose nucleoli and chromatin material stain intensely with haematoxylin. The cavity of the pharynx in this region has the shape of a Roman I, a narrow dorso-ventral slit and transverse dorsal and ventral arms (Fig. 9, l.) The intima of the dorso-ventral slit is very thick and the underlying epithelial cells are very large, cubical and with distinct cell walls. The intima lining the dorsal and ventral arms of the cavity is much thinner and the underlying epithelium is equally reduced in thickness.

The powerful circular muscles serve as constrictors for closing the lumen of the pharynx, while four sets of strong pharyngeal muscles serve as relaxers. On either side of the median portion of the pharynx are two horizontal rows of strong muscles, each row consisting of four separate muscles and a single very large anterior one. These muscles extend laterad and attach at the sides of the head. Their inner ends pass between the circular muscles and are attached to the large cubical epithelial cells by means of numerous radiating, zig-zag strands (Fig. 8, ph. m.) From the dorsal surface of the pharynx at the tips of the comb-like bars is a series of four strong muscles which extend dorsad to the surface of the head, joining it at its caudal margin. Low down on the dorso-cephalic margin of the expanded pouch-like portion of the pharynx are a number of strong muscles which extend dorso-cephalad to the surface of the head. The caudal portion of the pharynx with its heavy chitinous intima and strong constrictor and retractor muscles, must serve as a mill for crushing the food as it is passed on to the esophagus.

The pharynx ends and the esophagus begins beneath the caudal end of the brain (Fig. 4, es.) The circular muscles of the anterior portion of the esophagus completely clothe it, but the individual muscles are less strongly developed than those of the pharynx or those of the posterior part of the esophagus. Longitudinal muscles have not been found in any of the preparations. The epithelium is very thin. The cells forming it are without distinct walls and their small nuclei are arranged in definite rows along the dorsal, lateral and ventral surfaces of the esophagus. The large lateral cells of the pharynx give way in the esophagus to small cells which protrude into the lumen to form a longitudinal ridge on either side (Fig. 10, ep.) The

slight mid-dorsal and ventral protrusions of the epithelium in the pharynx, persist in the anterior part of the esophagus, forming a slight dorsal and a ventral longitudinal ridge. In the median portion of the esophagus these ridges almost disappear while in the caudal region there are two dorsal and two ventral ridges (Fig. 11, ep.) These dorsal and ventral ridges are simply thickenings of the cells opposite the nuclei while the lateral ones are formed by an elevation of the cells from the muscular coat and a protrusion of them half way in to the center of the lumen. The chitinous intima of the esophagus is well developed although much less strongly than in the pharynx. It becomes much folded and is usually severed from the epithelium by fixation. On the inner surface of the infolded intima of the esophageal valve, there are to be seen, with high magnification, a number of strong spine-like setae, but these are absent in the anterior portion of the esophagus (Fig. 17). They are so directed as to resist the passage of food from the mid-intestine back into the esophagus.

The salivary glands are quite prominent, each about the size of one of the lobes of the brain (Fig. 12). They are strongly reniform so that their free ends lie almost directly above their proximal ends. When the glands are not secreting their lumina may be very large, but during active secretion they are nearly obliterated. The cells are very large and protrude into the lumen so that in sections there are deep grooves between them. They have a coarse granular and vacuolate appearance, and are usually set off by distinct walls, except during active secretion when these may become obliterated. The nucleus is very large and centrally located, with deeply staining chromatin material and a very large nucleolus. The chitinous intima is quite thick but obscured by the granular nature of the underlying cells and the secretions in the lumen. The limiting basement membrane is very delicate, but stands out distinctly.

From the ventral anterior end of the glands, ducts pass forward and downward to a point beneath the sub-esophageal ganglia where the two join to form the main salivary duct. This main duct passes forward to the mouth where it opens on the surface of the labium between it and the hypopharynx. The intima of this duct is quite delicate posteriorly while the epithelium is more prominent, but near its anterior end both the intima and epithelium are prominent. Just before the duct

reaches the labium it is provided with a distinct press. The lower surface of the duct is attached to a strong chitinous process from the intima of the labium while a pair of very strong muscles is attached to the dorsal surface (Fig. 6, pr.) These two muscles extend laterad and slightly dorsad to their point of attachment to a prong of the tentorium. By their contraction the dorsal wall of the duct is drawn away from the ventral and the salivary secretions are permitted to escape into the mouth.

The circular muscles of the esophagus become greatly enlarged for a short distance in front of the esophageal valve and for some distance back into it (Figs. 14, 15 and 16, sp.) They thus function as a sphincter. The valve is strongly developed, the length of the inflexed portion of the esophagus being about equal to the diameter of the valve. The epithelium and intima of the inflexed portion are unmodified while those of the reflexed portion are much thinner and in longitudinal section appear as two heavy lines with here and there a nucleus in the epithelium (Figs. 14 and 15.) The reflexed portion extends a short distance cephalad to the anterior end of the mid-intestine and so forms a second, a caudally directed, loop. Circular muscles are absent from the caudal portion of the inflexed esophagus and from all of the reflexed portion. Between the inflexed and reflexed portions there is a large blood space, filled with the granular blood plasma and scattered blood corpuscles and traversed by numerous delicate fiber-like outgrowths of the reflexed epithelial cells (Fig. 16, s.) A number of these fibers and anteriorly protruding longitudinal muscles from the mid-intestine, meet the esophagus opposite the anterior end of the sphincter.

The point of union of the fore- and mid- intestine is plainly set off by the striking contrast between the epithelium of the two regions. The thin epithelium, of the reflexed part of the esophagus, gives way to a girdle of large deeply-staining cells, which extend about half the length of the esophageal valve. In longitudinal section from six to twelve large cells are seen to comprise this group on either side (Fig. 15, gl.) The anterior ones are short, polygonal and lie transversely, but further back they become strongly club-shaped and are directed mesocaudad. The outer ends of the cells are closely appressed while their inner ends are expanded greatly and form a smooth secre-

tory surface. The nuclei are large, with large nucleoli and coarse, deeply-staining chromatin granules, and lie in the expanded inner portion of the cells. These cells are glandular in nature. They stain far more intensely with haematoxylin than any other cells of the alimentary canal. They are granular and finely vacuolate toward their inner margins, where a thin layer of granular substance is to be seen (Fig. 18, p. m.) The inner margin of this granular layer hardens to form a delicate elastic peritrophic membrane which is continually fed back into the mid- and hind-intestine to envelope the food material. This membrane may be seen as a delicate envelope surrounding the excrement as it is thrown off. In some preparations the formation of the peritrophic membrane from the granular secretion can be seen very distinctly with the 1-12 immersion objective.

There are several views as to the origin of the peritrophic membrane in insects. By Pagenstecher ('64), it was thought to be a product of the salivary glands. Frenzel ('85) thought it was a product of the mid-intestinal epithelium. Simpson ('00) in an unpublished paper described it as a product of the mucus cells in Clisiocampa. Schneider ('87) considered it a chitinous prolongation from the esophagus. Van Gehuchten ('90) and Cuenot ('95) claimed that a ring of cells just cephalad of the mid-intestine produces it. In the larva of Psychoda alternata there can be no doubt as to the origin of this membrane. The girdle of cells at the anterior margin of the mid-intestine secretes it.

Behind and laterad to this girdle of cells comes a second girdle of glandular cells. In longitudinal sections seldom more than two cells are to be seen (Figs. 13, 15 and 46, c. gl.) They are very large, among the largest found in the alimentary canal, coarsely vacuolate, and have a straw-yellow color when stained with iron-haematoxylin. The nuclei are large, with rather small nucleoli and fine deeply staining chromatin granules. The cells pour their straw yellow secretion, which has a uniform finely granular consistency, into a pouch which opens widely into the lumen and extends latero-cephalad between the two rings of cells as seen in longitudinal sections. This pouch-like structure is simply a deep invagination on the inner surface of the gland.

Caecae are usually present in the larvae of Diptera, especially in the more specialized forms. They may be long, as in

the larvae of the blow-fly (Calliphora), but are more often short and inconspicuous. The number of caecae may be two (Ctenophora), four (Tipula, Simulium, etc.) or many as Miall and Hammond ('00) figure for the larva of the Harlequin fly. Vaney ('02) says that in Anthomyia there are four caecae, in Chironomus many, while in Stratiomyia and Tanypus they may be absent. In Tanypus he finds and figures a group of very large vacuolate cells with ectal diverticula which he claims function as caecae. This group of cells is similarly located, and the cells themselves, except for the ectal diverticula, closely agree with those described above for Psychoda. In Psychoda I am convinced that this group of cells is the rudimentary caecal glands. I find it also present in Pericoma. Caecae are said to be entirely absent in the larvae of Lepidoptera, which in this respect would seem to show a relationship between the Psychodidae and the Lepidoptera. There are not wanting a number of other characters which indicate such an affinity.

Behind the caecal gland comes a group of cells very similar to those which secrete the peritrophic membrane (Figs. 14 and 15). The cells stain quite deeply, are elongate and extend meso-caudad. They have numerous vacuoles which usually contain large spherical concretions (Fig. 19, con.) The nuclei are large with distinct nucleoli and intensely staining chromatin granules. The posterior extent of this group is marked by a few greatly elongated cells which project into the lumen (Fig. 14, ep.) It might be supposed that this group of cells assisted the anterior one in the production of the peritrophic membrane but from repeated examination of my specimens no signs of this have been found.

Caudad of this region comes a long stretch of fairly uniform cells. They are very large and cubical or polygonal (Fig. 2, ep.) The ones in front and behind are cubical, while those in the median region are longer than deep. Scattered among the large cells are to be found small slender ones (Fig. 21, ep.) The cells of this region are stained but slightly with iron-haematoxylin, are finely vacuolate, and possess a narrow but distinct striate border. The nucleus is large and the nucleolus and chromatin are sharply differentiated. These cells are secretory but do not take on the greatly elongated condition found in those farther back during most active discharge of secretion.

These large cells grade off posteriorly into a region of tall slender secretory cells (Fig. 2, ep.), comprising the posterior third of the mid-intestinal epithelium. These slender cells are finely vacuolate and have a very strongly developed striate border (Fig. 24, st. b.) The nuclei are small, usually centrally located, with deeply staining nucleoli and chromatin material. During active secretion, groups of these cells increase greatly in heighth and protrude into the lumen, giving to the inner margin of the epithelium a decidedly uneven surface (Fig. 23, ep.) In this respect, this region stands out in sharp contrast with the anterior region of large cells, where their inner margins form almost a straight line. Here and there among these slender cells as well as the larger anterior ones are to be found huge, coarsely vacuolate cells which protrude into the lumen. These have been described as mucus cells (Fig. 46, m. c.)

The striate border is more or less developed throughout the whole length of the secretory part of the mid-intestine, but its greatest development is to be found in the posterior region during active secretion and just before molting. Some of the earlier workers considered the striate border as a chitinous intima perforated by many fine canals. Later work goes to show, however, that it is simply a ciliate border, consisting of non-vibratile cilia, except perhaps in case of Chironomus larvae (Vignon '99). In Psychoda alternata it grades gradually from the vaculate tips of the cells into a clear homogenous border formed by closely appressed fine cilia. So gradual is the gradation and so intimate is the relation between the cell body and the border that I am inclined to agree with Van Gehuchten ('90) that the cilia are continuations of the cells rather than secretions deposited by them upon their inner margin.

The basement membrane is quite distinct throughout the whole length of the mid-intestine (Figs. 22 and 24, b. m.) In places it is considerably thickened. With perfect fixation the basement membrane remains closely connected with the epithelium. It bears on its outer surface, or more often in slight depressions of it, the numerous strands of circular muscles.

In the region of the esophageal valve, and for a short distance caudad, the circular muscles are weak and the strands far apart (Fig. 20, c. m.) But beginning with the region of very large epithelial cells and extending back along it a short distance the bands of circular muscles become much broader and more

regularly placed, with intervening spaces equal to the breadth of the bands. These broad bands give way to narrower and more widely separated ones, which continue back to the region of tall slender epithelial cells. Sections of these strands show their breadth to scarcely exceed the diameter of the nuclei of the underlying epithelial cells. At the point where the large epithelial cells give way to the tall slender ones, the strands of circular muscles are greatly crowded together, having the appearance of a slight sphincter (Fig. 22, c. m.) This crowding of the circular muscles covers but a short area and posteriorly gives way to a greater spacing of them, which extends back to the base of the Malpighian vessels.

The longitudinal muscles are not strongly developed in the mid-intestine. They consist of from ten to twelve narrow, flat strands, which fit closely to the surface of the circular muscles (Fig. 21 and 23, l. m.) Opposite the point, where the circular muscles are crowded together, these longitudinal strands are greatly thickened, almost circular in cross section and stand out from the circular bands more distinctly.

Just at the union of the mid- and hind- intestine are the five Malpighian vessels. In cellular structure they much more closely resemble the epithelium of the mid-intestine than that of the hind-intestine, but their glandular function will account for this, however. From embryological studies it has been shown that these vessels are outgrowths from the hind-intestine. At the point of attachment of these vessels with the alimentary canal they have a short, compact and slightly constricted region (Fig. 26, m. t.) Here the cells are large and alternately from opposite sides extend into the lumen of the vessels giving it a zig-zag course. The nuclei of these cells are oval with small nucleoli and fine chromatin granules. This constricted portion gives way to the much expanded, thin-walled reservoir. The epithelium of this region is very thin, with its inner surface delicately fibrillate and with valve-like projections here and there extending into the lumen (Fig. 27, c.) Beyond the reservoir comes the true glandular portion of the vessel which is much constricted and, in life, is charged with a reddish brown pigment (Fig. 27, a and b). Here the lumen is greatly reduced, being almost closed by the finely granular and vacuolate cells. These cells are very long, as can be seen from longitudinal sections, and as shown by some transverse sections, each cell

almost completely girdles the tubule, and forces the lumen toward one side, but more often the lumen is centrally located, the cell completely encircling the tubule. The basement membrane is strongly developed throughout the whole length of the tubule. The chitinous intima is slightly developed in the distal glandular portion, but seems to be absent in the basal portion.

The change from the mid-intestine to the ileum of the hind-intestine is a most striking one. The large secretory cells of the mid-intestine give way to the very small cells of the ileum (Fig. 26 and 28, ep.) These first cells are so very small that with the 1-12 immersion they appear as mere thickenings of the epithelium. The nuclei are very small, deep-staining, and without prominent nucleoli. A distinct, thin chitinous intima is present. This thin epithelium extends caudad to a point slightly before the middle of the ileum, where it develops a distinct fold, which extends into the lumen to form an ileal valve (Fig. 2, 29 and 31, il. v.) From this point to the union of ileum and colon, the epithelial cells are much larger, with enormous nuclei, in which the small nucleoli and coarse chromatin granules stain deeply. The ileum is well supplied with muscles. The delicate circular muscles of the mid-intestine are replaced in the ileum by very strong bands which completely clothe it. For a short distance, immediately behind the Malpighian vessels, the circular muscles are absent (Figs. 28-29.) From the point where the circular muscles begin, back to the ileal valve, there are two layers of them. The inner layer of delicate bands serves as a sphincter for the ileal valve, while the outer layer is continuous throughout the hind-intestine (Figs. 29 and 30). From the ileal valve back to the colon the individual bands of the circular muscles are much stronger and more oval than those of the anterior part of the ileum. The longitudinal muscles are only slightly developed in the hind-intestine. From longitudinal sections it would appear that, at the point where the first circular muscles appear, the longitudinal muscles divide to form an inner and an outer layer, but from cross sections only outer longitudinal muscles appear in front of the ileal valve. Three strong, and two or three smaller strands appear clustered together along either side of the canal. From the ileal valve to the colon these same lateral clusters of outer longitudinal muscles appear as well as scattered inner strands between the circular muscles and epithelium (Fig. 32, l. m.)

Posteriorly the constricted ileum projects into the expanded colon so as to form a slight valve (Figs. 2 and 33, v.) Just in front of this valve is a strong sphincter composed of five or six strong strands of circular muscles. The colon is slightly shorter than the ileum but its diameter is twice as great. Its epithelium is very thick, consisting of large cubical cells, of uniform finely granular nature, with distinctly striate inner curving margins which project into the lumen (Figs. 35 and 36, ep.) The cell walls are seldom distinct to the base. The nuclei are very large, and oval, with large nucleoli and fine chromatin granules. The basement membrane is very delicate and difficult of detection in most preparations. The circular muscles are strongly developed and are so fitted into pockets in the epithelium that their outer surface is just even with that of the epithelium (Fig. 36, c. m.) Longitudinal muscles have not been observed either in longitudinal or cross sections of the colon as well as the rectum. Sections of close-fitting nerve fibers were at first mistaken for longitudinal muscles. The chitinous intima is but slightly developed and closely adheres to the epithelium. Along the surface of the intima and especually down in the grooves between the cells is a layer of a finely granular deposit which stains blue with haematoxylin. This deposit is present in all of my preparations, which together with the enormous development of the epithelium, would suggest some association with absorption and I am of the opinion that in this larva much of the absorption of digested food takes place here.

The circular muscles of the anterior end of the rectum are much more strongly developed than are those of the colon (Fig. 37, c. m.) They lie on the surface of the epithelium and form a continuous layer. Farther caudad the individual bands decrease in strength rapidly. These circular muscles form a sort of sphincter about the rectum. The nuclei of the circular muscles are very large and are surrounded by undifferentiated protoplasm. The basement membrane is more strongly developed than in the colon. The epithelium is greatly reduced especially in the caudal portion where the cells are long and thin except opposite the nuclei, where they are thickened so as to protrude slightly into the narrow lumen. In the anterior region of the rectum the epithelium is thrown into six longitudinal folds (Fig. 37, ep.) The epithelium of the rectum is continuous

with that of the four slightly eversible anal papillae, where it becomes much thicker and the cells more vacuolate. The chitinous intima of the rectum is much heavier than that of the colon and its thickness increases toward the anus where it is continuous with the chitin of the anal papillae (Fig. 2, a. p.)

MORPHOLOGICAL CHANGES IN THE EPITHELIUM OF THE MID-INTESTINE.

In insects the changes, which the epithelium of the mid-intestine undergoes, are associated either with the pouring out of digestive secretions at the time of feeding or with the larval molting periods. These changes are marked by total or partial epithelial degeneration and regeneration. In the present work, special efforts have been made to get as complete series of larvae as possible in order to show the changes accompanying feeding and molting. By means of carefully timed starvation and feeding experiments, all desired stages associated with the feeding period were easily obtained. But it was much more difficult to get all the stages at the molting period, since the morphological changes in the mid-intestine are largely completed before the skin is cast and there is practically no forewarning as to just when the transformation begins. Only by means of a large series of specimens taken during the inactive period preceding and following the casting of the skin was it possible to get all the desired stages of transformation.

Changes Accompanying Feeding.

The extent of degeneration and regeneration of the epithelium of the mid-intestine, at the time of feeding depends upon the type of secretion found in the epithelial cells. Where the holocrine type of secretion prevails, partial or even total degeneration and renewal of the epithelium will follow each full feeding, while with the merocrine type only slight or no renewal will be found since the epithelial cells are not destroyed by the discharge of secretions.

The nymphs of dragonflies and adult water beetles, in which may be found the holocrine type of secretion, are excellent examples for the study of epithelial regeneration following feeding. Needham ('97) found that, in case of dragonfly nymphs, after prolonged fasts of two months, the cells became so gorged with digestive secretions that the epithelium became twice the height of the normal and when food was taken in

practically all of the cells were destroyed by the process of excretion and a complete new epithelium formed from scattered nidi or regenerating centers. Frenzel ('85), Vangel ('86), Bizzozzero ('93) and Rengel ('97) described even more striking cases of epithelial degeneration and regeneration in adult water beetles of the genera Hydrophilus, Hydrobius, Hydrous and Cybister. These beetles like the nymphs of dragonflies, feed intermittently, being able to fast for periods when food is not at hand and then when food is abundant, devouring great quantities of it. In these bettles the entire epithelium with its basal chitinous membrane is described as being cast off after each full feeding. The new epithelium is quickly developed from highly specialized regenerating centers or nidi, which protrude through the muscular coat of the canal, to form distinct diverticula.

The merocrine type of secretion is found in the mid-intestinal epithelium of those insects which feed continuously and which require a continuous supply of digestive fluids. In these forms the cells are always active, the extent of the secreting activity depending upon the extent of feeding. But since the cells are not destroyed by secretion and excretion there is no occasion for any regeneration in connection with the intake of food and digestion. This type of epithelial secretion was described by Van Gehuchten ('90 and '93) for Ptychoptera contaminata, there being no epithelial regeneration associated with digestion. Folsom and Wells ('06) describe this as the prevailing type of secretion in the mid-intestine of Collembola, there being no regeneration at the time of feeding.

Psychoda alternata in its larval state is not an intermittent feeder but is most at home at the mouth of open sewers, in cultures of decaying horse manure or other vegetable ferments, where it finds abundance of food always present. An occasional plankton form may be found mingled with the food but the bulk of the intestinal contents consists of bits of decayed vegetation. The larva is a voracious feeder and extremely active, scarcely refraining from feeding long enough to molt. The canal always has a great quantity of food material in it, even at the molting periods. From careful study of the epithelium of the mid-intestine of this form, I find the merocrine type of secretion prevailing and an absence of epithelial regeneration associated with feeding.

In hopes of being able to study to better advantage the type of secretion and of better understanding the relation of its discharge to the intake of food, I undertook a series of feeding experiments. Larvae were placed in small glass vessels with clean tap-water and kept there without food for periods varying from one to twelve days. The larger larvae invariably pupated before the experiments could be completed, so it was necessary to use larvae which were less than half grown. Larvae that had fasted for varying periods up to twelve days were killed and sectioned for determining what changes, if any, the mid-intestinal epithelium underwent during the fasts. Likewise larvae starved for two, three, four, seven and twelve days were removed to vessels containing abundance of food, and then after feeding for periods varying from half an hour up to seven hours, they were killed and sectioned for studying the epithelial changes accompanying feeding.

From a study of the preparations made from these larvae it was found that where the fast was prolonged more than four days, the mid-intestinal epithelium became so reduced and weakened that it failed to recover even though the larva survived the fast and fed freely for a time (Fig. 40). Simpson ('01, in an unpublished paper) found a similar degeneration of the epithelial cells of the mid-intestine of Clisiocampa larvae that had fasted for five days. When the fast is prolonged four days the cells take on a distinct vacuolate appearance associated with a heavy discharge of secretion (Fig. 39). After six or seven days this vacuolate condition has disappeared and the cells become greatly reduced in height. They almost cease to excrete digestive fluids and the striate border is then more conspicuous. Aside from a continued reduction in the height of the epithelium, and a greater shriveling of the cells, no further marked changes are brought about, the cells finally dying. At no time, even after a twelve day fast, is the mid-intestine completely free from food material. As a consequence there is a constant stimulus to the excretion of the digestive secretion and as the fast is prolonged the finely granular secretion is poured out and soon comes to fill most of the space between the reduced epithelium and the food content of the canal (Fig. 39, d. sec.) In place of the secretion being stored up in the cells as in the nymphs of dragonflies, it is continually poured into the lumen. This process soon drains the cells of their vitality,

since but little real nourishment can be absorbed from the already thoroughly digested content of the canal.

With larvae that had fasted less than four days no marked changes were found in the mid-intestinal epithelium. The food content of the canal is sufficient, apparently, to sustain the larva and to stimulate the cells of the epithelium to normal activities for this period so that when a fresh supply of food is taken in normal digestion is continued (Fig. 41). From the results of these expreiments, which comprised upwards of fifty separate lots of larvae, it was found necessary to turn to the preparations of the normal feeding larvae, for the determination of the type of secretion and the relation of its discharge to the intake of food.

For some time, the changes in the mid-intestinal epithelium just preceding the casting of the larval skin were mistaken for signs of an excessive production and storing of secretions, but when series of larvae preparing to molt were studied the mistake was detected. In this larva there are four sources from which the digestive secretions of the mid-intestine are derived.

As previously noted, the gastric caecae, usually present in the higher Diptera, are replaced in Psychoda alternata by a greatly reduced caecal gland which girdles the mid-intestine in the region of the esophageal valve. The large cells of this gland produce a yellowish digestive secretion similar to that of the gastric caecae of other insects. During most active secretion of these caecal glands, the cells become swollen and finely vacuolate (Figs. 18 and 47, c. gl.) The pouch, into which the secretion is poured, becomes so completely filled that its neck appears to flare, leaving a wide exit of the secretion into the lumen. During less active secretion and excretion the cells become somewhat reduced, the vacuolation less distinct and the pouch less distended with secretion or even almost empty. This is one source of digestive secretion.

A second source is the long stretch of very large cells caudad of the esophageal valve (Fig. 2, ep.) These cells during active secretion and excretion give off a finely granular secretion. This secretion is not given off as globules or droplets but simply oozes through the thin striate border of the large finely vacuolate cells and comes to fill all the space between the epithelium and the peritrophic membrane (Fig. 42). This is perhaps the most abundant supply of digestive secretion found in the mid-intestine of this form.

Just caudad of the point where the region of large cells gives way to that of the tall slender ones, comes a group of cells which during active secretion becomes greatly elongate and protrude into the lumen. These cells are active in throwing off small spherical bodies of their protoplasm by the pinching off of their tips, which float out into the lumen to dissolve and form a third supply of digestive secretion (Figs. 43 and 44, sec. p.)

The fourth source of digestive secretion is the less elongate epithelial cells farther caudad. These cells are more granular and vacuolate next to the striate border and throw off distinct globules which collect along the margin of the striate border (Fig. 45, sec. g.) These globules seem to burst and give out a secretion similar to the finely granular material of the anterior part of the mid-intestine. The striate border becomes less distinct where the cells are actively secreting and excreting but is never completely obliterated.

The mucous cells of Leidig ('57), Frenzel ('82 and '85), Korotneff ('85), Beauregard ('86), Fausseck ('87), Mingazzini ('89), Balbiani ('90), and Simpson ('00 in unpublished paper) are present in this larva. They are scattered among the large secretory cells of the anterior region as well as among the tall slender cells of the posterior region. As compared with the surrounding cells they are truly monsters (Fig. 46, m. c.) They are connected with the basement membrane by a constricted pedicle while the distal end is enormously expanded and protrudes into the lumen. They are coarsely vacuolate throughout but especially so toward the inner end. The nucleus is scarcely larger than those of adjoining cells, and does not differ from them in the arrangement of nucleolus and chromatin material. Some writers have attributed to these cells the function of secreting the peritrophic membrane, others claim that their secretion serves as a lubricant. In the larva of Psychoda alternata these cells certainly have nothing to do with the secretion of the peritrophic membrane. The fact that the secretion of these cells resembles that from surrounding cells microscopically, that their greatest activity corresponds with that of the surrounding cells and the fact that the food, enveloped in the peritrophic membrane, is continually floated, so to speak, in digestive fluids, cause me to hesitate to accept the view that the secretion of these cells is merely a lubricant. I am inclined to believe that here we have simply specialized digestive cells.

The slender cells, of the region immediately caudad of the caecal glands, have a coarse granular and finely vacuolate structure. In some preparations a slight discharge of granular secretions is to be seen although this is more frequently absent. The striate border is only slightly developed. Between the middle and distal margin of these cells are to be found vacuoles of various sizes which inclose dark brown concretions (Figs. 19 and 47, con.) These concretions are spherical, almost completely filling the vacuoles and very dense. I have not found them in any of the other epithelial cells of the mid-intestine of this larva. They closely resemble those found by Folsom and Wells in the mid-intestinal epithelium of Collembola, and are probably waste products which are secreted and held by these cells until the molting period when they are discharged along with the cells. If my interpretation of these concretions is correct these cells have a definite excretory function.

Passing forward to the anterior region of the mid-intestine we find the cells which produce the peritrophic membrane. These cells are especially active during feeding. They appear long, club-shaped and become finely vacuolate on their inner margin. From them is discharged a finely granular secretion, which forms a narrow inner border to the cells (Figs. 18 and 47, p. m.) It is difficult to tell just where the cell-body ends and the layer of secretion begins. On the inner surface of this border a portion of it hardens to form the thin uniform peritrophic membrane which closely resembles the chitinous intima of the esophagus. From the reaction of these cells to stain it is evident that they are secreting continuously; but the underlying border of secretion is especially prominent at certain times. The course of most active secretion seems to pass along the canal like a wave, following the entrance of a new supply of food somewhat as found in dragonfly nymphs. By the time the discharge of secretions in the posterior part of the mid-intestine has reached a maximum it has begun to decrease in the anterior portion. This is the case with the cells producing the peritrophic membrane as well as those of the caecal glands.

Changes at the Molting Periods.

It is well known that, with each larval molt, the entire outer cuticula, as well as the intima of the fore- and hind-intestine and the tracheal system, are cast. Sharp ('95) maintains that the facilitation of growth by the casting of the chitinous coat is

only of secondary importance. The discharge of the chitinous coat is merely an outward sign that internal changes have been going on. Eisig ('87) suggests that since chitin is a nitrogenous substance, perhaps the casting of the chitinous coat is a means of disposing of nitrogenous wastes, to which Sharp adds that perhaps the same is true of carbonaceous wastes. If the casting of the exuviae has an excretory function associated with it and if the epithelium of the mid-intestine has an ectodermal origin, as believed by some writers, then it will be easier to explain certain morphological changes which occur in the mid-intestinal epithelium at the time of molting. The striking morphological changes undergone by insects at the time of pupation and emerging of the adult, are well known and have been given much attention by workers, but there are similar although perhaps less intensive changes at each larval molt, which have been almost entirely overlooked. We shall now consider the changes in the mid-intestinal epithelium at the time of molting.

Folsom and Wells' ('06) work on epithelial degeneration, regeneration and secretion in the mid-intestine of Collembola deals primarily with the changes in the digestive epithelium at the molting periods. The Collembola are among our most primitive forms of insects, lacking Malpighian vessels and developing without obvious metamorphosis. With this type of development we should expect to find equivalent morphological changes at the different molting periods. Conditions found in the study of a form of this generalized type will not necessarily be like those in higher forms but are suggestive for one making a study of any more specialized form.

The normal epithelium of the mid-intestine of Collembola was found to be composed of very large granular and finely vacuolate cells. At the approach of an ecdysis the cells begin elongating and the inner half becomes more vacuolate. As this vacuolation continues, any concretions and gregarine parasites present in the cells and about half of the nuclei migrate from the more dense portions of the cells into the inner, more vacuolate region. Then comes a cutting off of the inner half of the epithelium. During these changes cell walls are obliterated. A new striate border forms along the line of constriction and the inner portion of the epithelium is cast into the lumen where it is digested. To replace the nuclei lost by the sloughing off, those remaining undergo mitotic division, cell boundaries

reappear and the normal epithelium is again restored. Since the forms studied lacked Malpighian vessels, Folsom & Wells concluded that this periodical discharge of half of the epithelium with concretions, inclusions and parasites had an excretory function similar to that of the Malpighian vessels in other insects. The short inactive period preceding each molt made it possible to get any desired stage of transformation. Here we find only partial epithelial regeneration at each molting period.

We shall now consider a more specialized type of insect, one with complete metamorphosis, and see how the changes in the mid-intestinal epithelium at the time of the larval molts compare with those in Collembola at the molting periods. Mobüsz ('97) studied the changes in the mid-intestinal epithelium of Anthrenus during the larval molts and found that the same changes appeared then as at pupation, only less intensive. In the study of his preparations, which included larvae in various stages of transformation, he found a large mass of material in the lumen of the mid-intesine which he first mistook for parasites. Further studies revealed to him that this inclusion was simply the remains of the sloughed off epithelium. He was able to find various stages in the throwing off of the old cells from that in which, by muscular contraction and development of the new epithelium, the old with its basement membrane was separated from the muscular coat, to that in which it was cast into the lumen and digested leaving its residue enveloped in the resistant basement membrane. Mobüsz takes exception to Rengel's work on Tenebrio molitor ('96) where he describes the nidi as being cast off with the old epithelium and basement membrane and later making their way through the basement membrane and regaining an attachment to the muscular coat. Rengel must certainly have had faulty preparations. Mobüsz found the nidi retaining their attachment with the muscular coat and concluded that either, the cells of the nidi being embryological, no basement membrane was produced beneath them, or if produced it was dissolved so that it would slip off over them when it was cast off with the old epithelium. By multiplication the cells of the nidi quickly produce the layer of new epithelium. In fact these first changes are produced with such rapidity that Mobüsz failed to catch them in any of his specimens. The new epithelium soon developes its basement

membrane and striate border and in time the nidi take on their normal condition and the new epithelium is mature. Here we find the epithelium cast off bodily and not merely in part. In conclusion Mobüsz maintains that:

(1) At each larval molt there is a total regeneration of the epithelium of the mid-intestine.

(2) The transformation of the mature larva to the pupa, in the holometabola, is simply an intensified larval molt and we may expect the same morphological changes, although to varying degrees, perhaps, at these periods.

(3) He believes that there is not only total regeneration of the mid-intestinal epithelium but also that there are greater or less changes in the epithelium of the fore- and hind-intestine and in the muscular and adipose tissues of the larva.

The larva of Psychoda alternata on preparing to molt, ceases feeding for a short time and to a marked degree discharges the food content from the alimentary canal. Then comes a short period of inactivity followed by pronounced peristalic contractions. In the thoracic region a strong ventral flexure occurs and then peristaltic waves of contraction pass forward from the posterior end of the body. This may be repeated a number of times before the chitin bursts on the dorsum of the first two thoracic segments and the larva crawls out. As soon as the larva is free it becomes quite active and begins to feed. These outward signs of transformation are simply the culmination of the metamorphosis. The internal changes are practically completed before the larval skin is cast.

Shortly before the time of molting the mid-intestinal epithelium begins to undergo striking changes. The cells begin to elongate and protrude into the lumen. Their distal halves become distinctly vacuolate (Fig. 48). There is to be noted in the nuclei themselves some change. The chromatin usually disappears or comes to closely envelope the nucleolus. At this stage the cytoplasm and enclosed secretions of the cells stain intensely with iron haematoxylin which can be removed only by prolonged differentiation.

This stage in the metamorphosis was first observed in a larva that had fasted for three days and was thought to be due to the storing up of digestive secretions, but when other specimens from the same lot were examined and no signs of such development found and when larvae, that were known to be

ready to molt, were examined and the same identical conditions found, the theory of stored up secretions was discarded. This condition of degeneration of the mid-intestinal epithelium has also been found in some specimens collected at random for general structural work, they having been caught in the act of transformation.

A later stage shows these epithelial cells becoming more broken up by large vacuoles. The entire distal portion of the cells becomes vacuolate with strands of cytoplasm surrounding the vacuoles (Fig. 49). The vacuoles at first circular in section become irregular in shape as their size increases, while the nuclei are found moving out into the distal more vacuolate portion of the epithelium. All signs of cell boundaries are lost and the epithelium resembles a mass of ragged cytoplasm with nuclei scattered about through it. In the cytoplasm small round concretions are usually present in great abundance, especially in the more vacuolate portion (Figs. 48 and 49, con.) Gregarine parasites are seldom found within the epithelium. The nuclei degenerate unevenly. Some near the basement membrane may retain a more healthy appearance with chromatine granules and large nucleolus, while those beginning to migrate lose their chromatin. At this stage of degeneration, there appears in the lumen of the mid-intestine, surrounding the peritrophic membrane and enveloped food contents, a great mass of finely granular and deeply staining secretion which is evidently the product of the degenerating cells of the epithelium. This deposit seems to be confined largely to the posterior half of the mid-intestine where the epithelium consists of the tall slender cells. In this bluish-staining deposit are to be seen scattered remains of degenerating nuclei, especially nucleoli, which seem to be especially resistant. Scattered through this deposit are also to be found deeply staining bodies, probably concretions, and a quantity of uniform yellowish secretions, evidently a product of the degenerating cells.

This degeneration of the mid-intestinal epithelium begins in the posterior portion where the cells are long and slender and as metamorphosis advances, the process of degeneration may be traced forward to the esophageal valve (Figs. 50 and 51). When the large cells of the anterior half of the mid-intestine have become strongly vacuolate, those of the posterior part have almost completely broken down and their contents cast

into the lumen. The method, by which the midintestinal epithelium, in this form, is cast off, in no wise resembles that described for Hydrophilus, after feeding, where the epithelium with its basal chitinous layer is cast off bodily; nor is it so complete and regular as that described by Mobüsz for Anthrenus. It more nearly resembles the degeneration of the mid-intestinal epithelium of dragonfly nymphs after feeding. The individual cells themselves break down and are sloughed off rather than the epithelium in mass being cast into the lumen.

The extent to which this degeneration takes place is not always easy to determine. It can be followed to where practically all of the old nuclei have migrated out into the lumen and degenerated (Fig. 51). And where practically all of the cell content is dissolved, although for a time, at least, a quantity of the cytoplasm remains in contact with the basement membrane, which is not cast off. I am inclined to believe that this is as far as the degeneration of the mid-intestinal epithelium proceeds in this form. The old adhering cytoplasm is apparently absorbed by the newly developing epithelium.

Between the epithelium of the mid-intestine and its underlying basement membrane are to be found numerous very small regenerating cells from which the new epithelium is developed (Figs. 48, 49, 50, 51, r. c.) These small cells are extremely difficult of detection except at the time of transformation. Cell division takes place in these embryonic cells while their diameter is yet scarcely one-fifth that of the nucleus of mature epithelial cells, so that it is extermely difficult to make out the type of division, but from a study of my preparations it would seem that here we have direct cell division (Fig. 54). They may be collected in small groups or in pairs or scattered singly along the basement membrane. The first structure that can be definitely made out is the deeply staining nucleus, but as the degenration of the old epithelium advances, a definite cell form can be distinguished. The cytoplasm at the beginning is a mere border about the nucleus, but as development advances it rapidly increases in bulk and comes to form a distinct cell body about the nucleus. By the time the old epithelium is nearly all sloughed off these new cells have come to protrude up into the adhering cytoplasm of the old cells, which they seem to absorb in part (Fig. 51, r. c.)

These conditions of degeneration and regeneration of the mid-intestinal epithelium are found in larvae previous to the casting of the larval skin. Changes at this point take place with very great rapidity so that it is easy to see how former workers came to overlook, almost completely, this degeneration and regeneration of the mid-intestinal epithelium at the larval molting periods.

In larvae, taken immediately after the casting of the skin, the new epithelium of the mid-intestine is already developed. At first the cells are low and stain deeply with iron haematoxylin (Fig. 52, ep.). The nucleoli are large and stain deeply, while the chromatin material is not distinctly made out. The cytoplasm is coarsely granular and has the appearance of being striated next to the lumen. The striate border is developed early and appears even more distinct than in later stages when the cells have begun to secrete (Figs. 52 and 53, st. b.)

The contents of the mid-intestine, not cast off before metamorphosis began, is still found to be enclosed in the resistant peritrophic membrane and occupies the central portion of the lumen. Between this central mass and the new epithelium, there is still to be found a great quantity of the finely granular yellowish product from the degenerate epithelium. Occasionally the sloughed off intima of the esophagus is found coiled about in the mid-intestine, but the degenerate epithelium of the mid-intestine is so completely dissolved that only the slightest traces of it are to be found after the skin has been cast.

In this way the epithelium of the entire mid-intestine, including the caecal glands and the group of cells which produce the peritrophic membrane, is renovated at each larval molt. As soon as the metamorphosis is completed and the skin cast off the larva resumes activity and begins to feed again. The new cells of the mid-intestinal epithelium at once respond to the demand made upon them for secretions and the larva enters upon the next stage of its development.

CONCLUSIONS.

The alimentary canal of the larva of Psychoda alternata is a generalized one in conformity with the habits of the larva. Both the fore- and hind-intestine are relatively short while the mid-intestine makes up at least two-thirds of the entire length of the canal.

Longitudinal muscles are absent in the fore-intestine and in the colon and rectum.

Gastric caecae are replaced by a caecal gland, which girdles the median portion of the esophageal valve.

There are five Malpighian vessels of similar form and structure, two extending cephalad and three caudad.

The rectum is prolonged into four slightly eversible papillae, which are homologous with the anal tracheal gills of Culex and related forms.

The epithelium of the mid-intestine is divided into five distinct regions; an anterior one giving rise to the peritrophic membrane, a caecal gland, a small area of long glandular cells, a long stretch of large polygonal cells, and the posterior region of tall slender cells. The so-called mucus cells are abundant. There is no regeneration of the epithelium of the mid-intestine at the time of feeding. During a fast, secretions are not stored up in the epithelial cells but are continually poured out and if the fast be prolonged the cells may completely break down. The peritrophic membrane is secreted by a definite group of cells at the anterior end of the mid-intestine.

At each larval molt the epithelium of the mid-intestine is completely renewed. The old cells are not cast off as a whole, but the degeneration begins next to the lumen and continues until the whole cell is broken down. This degeneration begins in the posterior region of the mid-intestine and proceeds forward.

Regeneration is from scattered embryonic cells which lie in the angles at the base of the epithelial cells. The regenerated epithelium of the mid-intestine is mature by the time the larval skin is cast off.

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LIST OF ABREVIATIONS.

a. p., anal papillae.
b. c., blood corpuscles.
b. m., basement membrane.
br., brain.
c., concretion bearing cells.
c. gl., caecal gland.
c. m., circular muscles.
col., colon.
com., commissure.
con., concretion.
d., salivary duct.
d. c., degenerating cells.
d. sec., digestive secretion.
ep., epithelium.
eph., epipharynx.
es., esophagus.
es. v., esophageal valve.
f., food.
gl., gland which secretes the peritrophic membrane.
hy., hypopharynx.
il., ileum.
il. v., ileal valve.
in., intima.
l., lumen.
la., labium.
l. m., longitudinal muscles.
lr., labrum.
m., mouth.
m. c., mucus cell.
md., mandible.
m. int., mid-intestine.
m. t., Malpighian tubule.
mx., maxilla.
mx. p., maxillary palpus.
n., nucleus.
nl., nucleolus.
n. m., nuclear membrane.
p., caecal gland pouch.
ph., pharynx.
ph. b., pharyngeal bars.
ph. m., pharyngeal muscles.
pr., press of salivary duct.
r. c., regenerating cells.
rec., rectum.
s., blood space.
sec. c., secretory cells.
sec. p., secretory proliferations.
s. g., salivary gland.
sp., sphincter.
st. b., striate border.
vac., vacuole.
v., valve between ileum and colon.

EXPLANATION OF PLATES.

PLATE XLIV.

1. Alimentary canal in surface view.
2. Longitudinal section of alimentary canal.
3. Mouth parts.
4. Anterior end of larva with alimentary canal and nervous system in situ.
5. Longitudinal section through the anterior portion of the head.
6. Transverse section through the anterior end of the pharynx. Plane of section sloping slightly dorso-caudad.
7. Transverse section through the median portion of the pharynx. Plane of section sloping slightly dorso-caudad.
8. Portion of the transverse section through the pharynx in the region of the large lateral pharyngeal muscles.
9. Transverse section through the caudal region of the pharynx.
10. Transverse section through the anterior region of the esophagus.
11. Transverse section through the anterior end of the esophageal valve. Plane of section sloping slightly dorso-caudad.

PLATE XLV.

12. Longitudinal section of salivary gland.
13. Transverse section through the middle of the esophageal valve. Plane of section sloping slightly cephalad to the right.
14. Longitudinal section of esophageal valve.
15. A portion of longitudinal section of esophageal valve.
16. Longitudinal section of cephalic end of esophageal valve showing a portion of the blood space.
17. Longitudinal section through the tip of the infolded portion of the esophagus, showing chitinous spines.
18. A portion of a longitudinal section through the region of the caecal gland.
19. Cells with enclosed concretions, from the region immediately caudad of the caecal gland.
20. Longitudinal section through the region at which the concretion-bearing cells give way to the large polygonal digestive cells.

PLATE XLVI.

21. Transverse section of mid-intestine through the region of large polygonal digestive cells.
22. Longitudinal section through the region at which the polygonal cells give way to the tall slender ones.
23. Transverse section of mid-intestine through the region of tall slender cells.
24. Longitudinal section through the region of tall cells.
25. Transverse section through the region at which the Malpighian vessels join the alimentary canal.
26. Longitudinal section through the same region.
27. Transverse sections of Malpighian vessels. (a and b) Through the pigmented secretory portions, (c) through the basal reservoir.
28. Transverse section of the ileum immediately caudad of the Malpighian vessels, showing absence of circular and longitudinal muscles.
29. Longitudinal section of the anterior portion of the ileum.

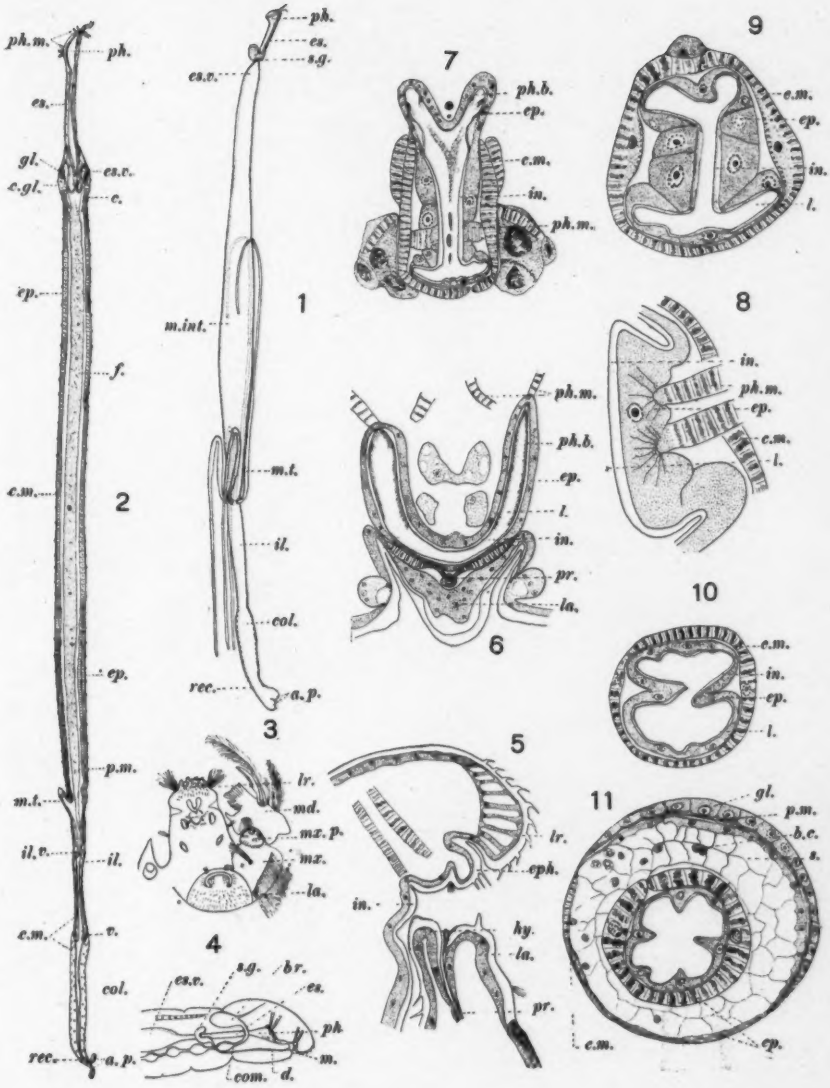
PLATE XLVII.

30. Transverse section through the ileum just cephalad of the ileal valve.
31. Longitudinal section through the ileal valve.
32. Transverse section through ileum, caudad of the ileal valve.
33. Longitudinal section through the valve between the ileum and colon.
34. Transverse section through the valve between the ileum and colon.
35. Transverse section through the colon.
36. Portion of longitudinal section through the colon.
37. Transverse section through the rectum.
38. Longitudinal section through the rectum and anal papillae.

XLVIII.

Epithelial secretion and regeneration (with 1-12 immersion.)

39. Epithelial cells of the mid-intestine of a larva after a four days' fast.
40. (a) Epithelial cells of the mid-intestine of a larva after a seven days' fast. (b) Same after feeding half an hour.
41. Epithelial cells of mid-intestine of a larva that had fasted two days then fed for half an hour.
42. A single large polygonal digestive cell from the anterior portion of the mid-intestine.
43. Tall slender epithelial cells discharging digestive proliferations.
44. Same, from region slightly cephalad of (43).
45. Epithelial cells from the posterior region of the mid-intestine discharging globules of digestive secretion.
46. Mucus cells from posterior region of mid-intestines.
47. Longitudinal section through the caecal gland.
48. Epithelial cells from the anterior portion of the mid-intestine shortly before molting, showing the first stage of epithelial degeneration.
49. Epithelial cells showing a later stage of degeneration.
50. Epithelial cells from anterior portion of mid-intestine showing the process of degeneration well under way.
51. Epithelial cells from the same larva, but from the region of tall slender cells with degeneration almost complete.
52. Newly regenerated epithelium of the mid-intestine of a larva that had just emerged from the larval skin.
53. Epithelium of the mid-intestine of a larva that had molted less than a day previous to killing.
54. Embryonic cells in various stages of development.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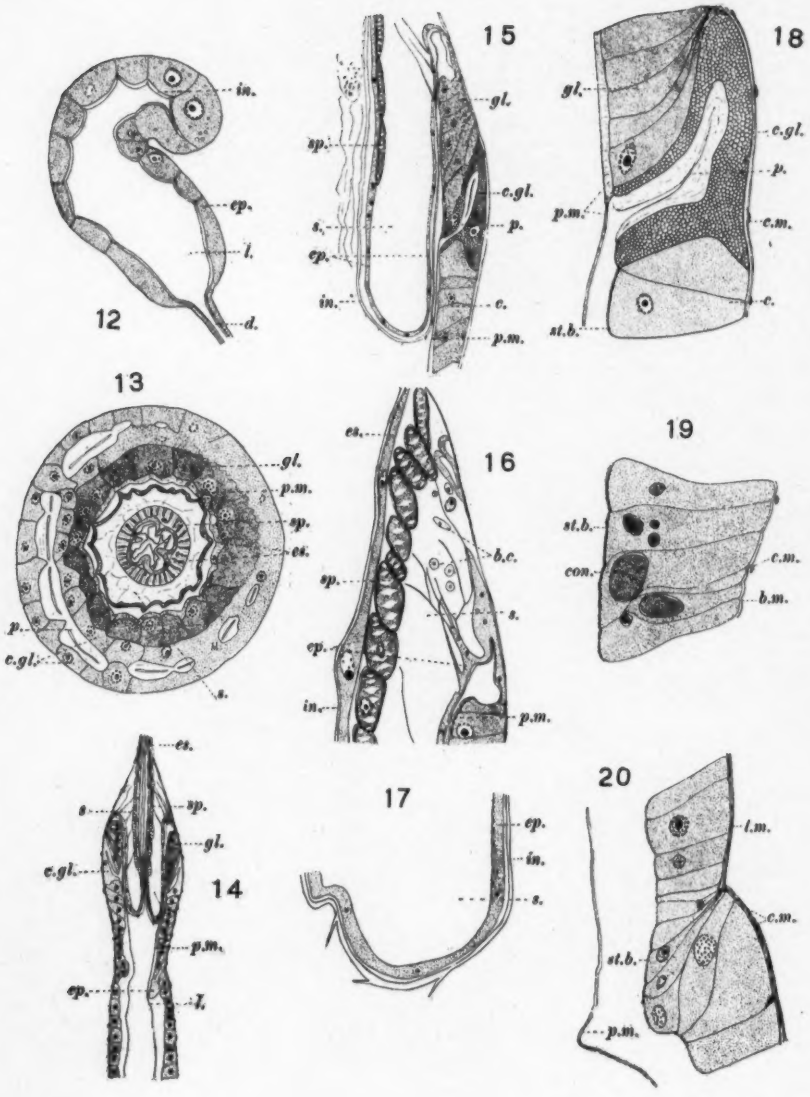
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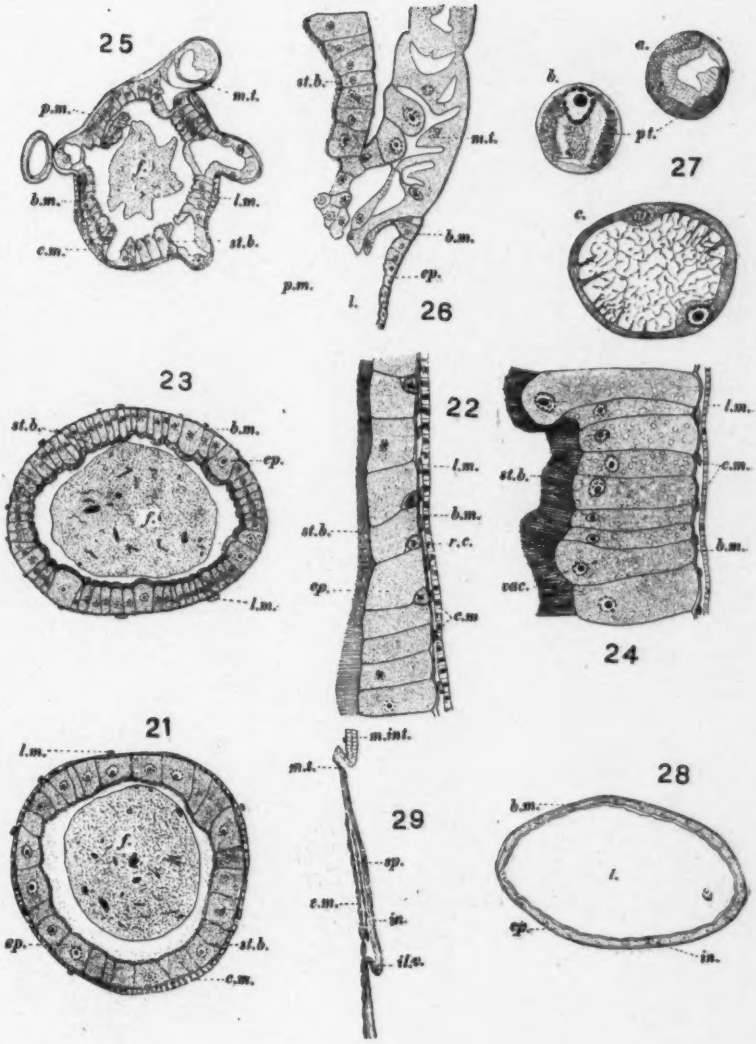
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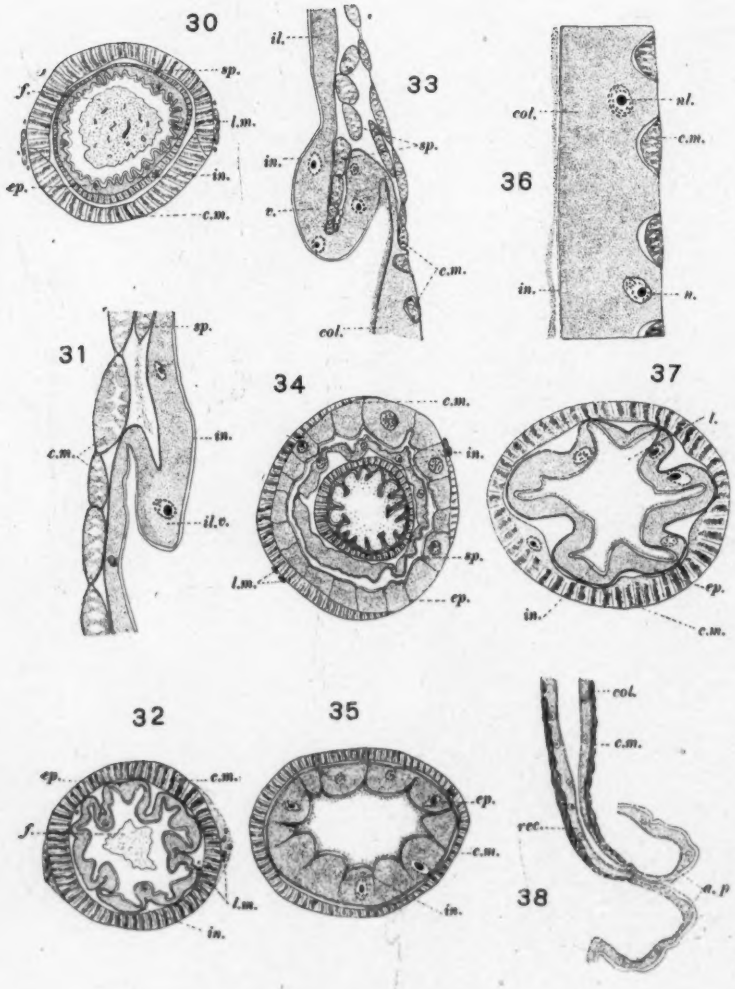
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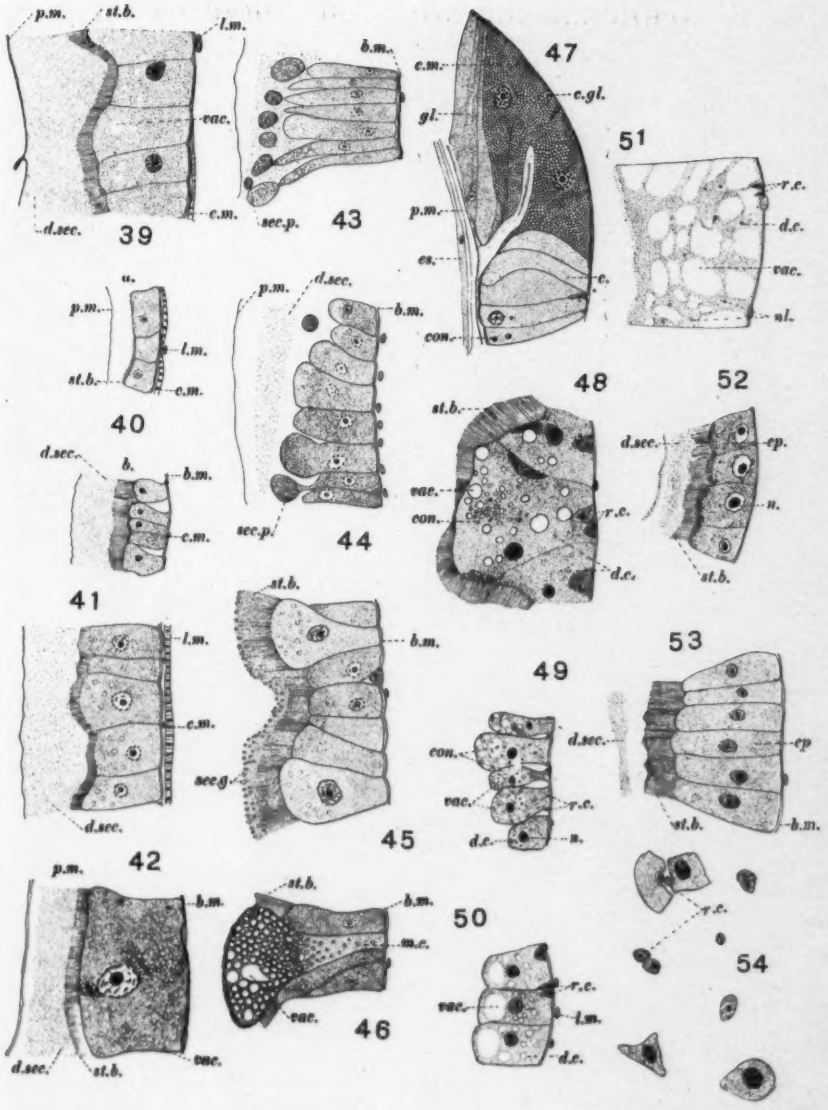
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L. Hausman.

A KEY TO THE GENERA OF THE SUBFAMILY APHIDINAE AND NOTES ON SYNONOMY.

By H. F. WILSON,
Oregon Agricultural College.

The following paper is not as complete as the author would like to have it as type species of four recently formed genera are not available. Several attempts have been made to secure the desired species without success and as there does not seem to be much chance of securing them in the near future copies of the original keys are included in this paper. All of them were made by Del Guercio and three of them are given as a division of the so called genus *Aphis*.

The first three are given in Redia (vol. 4, pp. 190–192, 1907) with the following key.

1. *Femine partenogeniche attire ed alate sprovviste di codetta o con questa affatto rudimentale.*
   Gen. ANURAPHIS *Del Guercio*
   (Sp. tip. *Aphis pyri* Koch).
   Femmine attere ed alate con codetta distinta.....2
2. *Codetta costantamente piu corta dei sifoni.*
   Gen. APHIS *Linne*
   (Sp. tip. *Aphis sambuci L.*)
   Codetta constantamente eguale, o piu lunga dei sifoni.....3.
3. *Codetta piu lunga dei sifoni.*
   Gen. URAPHIS *Del Guercio*
   (Sp. tip. *Aphis genistae* Kalt.)
   Codetta della stessa lunghezza dei sifoni.
   Gen. MICROSIPHON *Del Guercio*
   (Sp. tip. *Aphis tormentillae* Pass.)

The fourth was published two years later (Rivista di patologia X Vegetale anno IV Num. 11. Agosto 1909. pp. 4–5.) This species is given as the dividing line between *Anuraphis* Del Guercio and *Myzus* Passerini.

A. *Codetta verricuforme, rudimentale o nulla.*
I. *Femmine attere con tubercoli frontali nulli, in ogni caso evidentemente piu corti della meta della fronte; antenne corte col primo articolo subeguale al secondo.*
   Gen. ANURAPHIS *Del Guercio.*
II. *Femine attere con tubercoli frontali piu lunghi della meta del margine della fronte fra essi compressa: primo articolo del antenne, che sono lunghe, due volte piu lungo del secondo.*
   Gen. MACCHIATIELLA *Del Guercio.*
AA. *Codetta hen distinta*
   Gen. MYZUS *Passerini.*

In working up synonomy from a standpoint of literature there seems to be a great difference of opinion. However since an International Code has been established there seems to be but one correct plan and if followed in all cases the troubles of the systematist must soon disappear. One of the rules of the code in substance states that if a number of species belonging to distinct different genera are arranged under a certain genus without a type being set by the maker of the genus then the type may be any one of the original species. If all the species but one are removed without a type being set then the last species is the type.

In 1758 Linnaeus formed the genus *Aphis* without setting a type. In this genus he included a large number of species which have been placed in various different genera, and *Aphis sambuci* is now generally taken as the type of the original genus. In 1801 Lamarck* set *Aphis ulmi* as the type and *Aphis sambuci* was not set until a year later by Latreille.†

Aphis ulmi L. is the species generally known as *Tetraneura ulmi* DeGeer. This species was first described and figured by Reaumer previous to the 10th Edition of Linnaeus. Linnaeus and DeGeer give the same citation, so the species does not belong to DeGeer. *Schizoneura ulmi* Linn. is the species designated by himself as *Chermes ulmi*.

The author of this paper will not at this time attempt to say that any of the above names should be changed, but it seems that a decision of some kind as to the disposal of the above should be made.

In making the key type species of each genera were used and more or less detailed descriptions taken of the external characters. In several instances wide variations were noticed among the species included in certain genera and some were separated to form new genera.

In studying closely related genera the development of external characters may be placed in five divisions. 1. The antennae and spur. 2. The antennal tubercles. 3. The development of the nectaries. 4. The development of the cauda. 5. The development of the wing venation. In a group of insects as pliable as the present one, any one or two of these characters

* Systeme des animaux sans vertebres, ou Tab. gen. classes, des orders et genercs animaux A. Paris, an. IX, p. 300. 1801.

† Histore Naturelle Gen. et par. Des Crus. et Ins. Tome III, p. 264. 1802.

may be either under or over developed and it is necessary to place the genera according to the greatest development. Of all the characters which show this variation the wings show what may be true of all the characters.

Along these lines the subfamily has been divided into three tribes as follows:

A. Nectaries nearly as long as the body and with long hairs.....**Trichosiphini.**
— Nectaries without hairs and not more than half as long as the body.....B.
B. Nectaries variable in length but at least one fourth the length of the body. Antennae as long as the body or longer and set on distinct antennal tubercles. The antennae of Phorodon are shorter but the tubercles are greatly developed..... **Macrosiphini.**
— Nectaries variable in length; antennae usually shorter than the body and not set on distinct antennal tubercles. When tubercles are present antennae and nectaries are much reduced.....**Aphidini.**

Tribe TRICHOSIPHINI

This tribe is limited to two genera both of which are found in the Asiatic Islands. The nectaries are quite remarkable in that they are covered with long hairs. In other respects they are not so different from the genera of the other two tribes.

I. Antennae not longer than the body and the cubital vein twice forked. **Trichosiphum.**
II. Antennae longer than the body and the cubital vein with but one fork. **Greenidea.**

Gen. **Trichosiphum** Pergande

type *anonae* Pergande.

Antennae about as long as the body, six, segmented, and fixed on large tubercles; spur of sixth segment shorter than third segment; first segment gibbous. Antennal tubercles slightly tapering but not gibbous being oblique to the forehead which is nearly flat. Body elongate and narrow; stigma of wing long and slender; cubitus twice forked. Nectaries as long as the body cylindrical, and standing out at right angles to the body. Cauda short and triangular; anal plate short, half moon shaped. Antennae, legs, and nectaries as well as the body covered with long bristle like hairs.

Apterous female:—Body short, robust, with antennae one half the length of the body; six segmented, with small antennal tubercles. Nectaries one fourth the length of the body and vasiform. Cauda short and broadly rounded; anal plate broad and slightly emarginated at the center. Antennae, nectaries, legs and body exceedingly hairy.

Gen. **Greenidea** Schouteden.

type *S. artocarpi* Westwood.

Antennae longer than the body and six segmented; spur of sixth shorter than the third segment; first segment slightly gibbous on the inner side. Antennal tubercles large and tapering, front of head wide and flat. Body long and slender, wings long, venation variable but usually the cubitus is but once forked. Nectaries almost as long as the body, slender and nearly cylindrical. Cauda short, broader than long and rounded at the tip; base slightly constricted; anal plate rounded. Body and appendages exceedingly hairy.

Tribe MACROSIPHINI

The author has divided this group from the following in order that the key may not contain too many conflicts. The division is made between species having distinct antennal tubercles and those having none or at the most indistinct tubercles. However should a certain species have distinct antennal tubercles with the other characters wanting then it would have to go in the next tribe.

I. Antennal tubercles tapering and very large, not gibbous on the inner side. II.

— Antennal tubercles gibbous or toothed on the inner side. III.

II. Nectaries nearly half as long as the body, cylindrical and curved. **Illinoia.**

— Nectaries at least one fourth the length of the body and vasiform. **Nectarosiphon.**

III. Antennal tubercles large, and as long on the outer side as on the inner; upper inner angle more or less gibbous. Nectaries variable. IV.

— Antennal tubercles prominent but not large and the inner side longer than the outer or else outer side is but a line. VI.

IV. Nectaries tapering longer than the cauda which is sickle shaped. Wings regular with twice forked cubitus. **Macrosiphum.**

— Nectaries and cauda variable, wing venation irregular but very striking. Veins either wanting or else combined. V.

V. Antennal tubercles with sharp upper inner angle, cauda shorter than the nectaries and tapering. Stigmal and cubital vein almost meet in a broad dark band, giving the wing the appearance of having a closed triangular cell. **Idiopterus.**

— Antennal tubercles with small round tubercle at upper inner angle. Nectaries tapering and slightly longer than tapering cauda. Wing venation variable but usually with the cubitus once forked, and the hind wing with but a single oblique vein. **Microparsus.**

— Antennal tubercle with small rounded tubercle at upper inner angle. Nectaries constricted at the middle and tip. Wing venation variable but usually the stigmal and cubital veins are partly joined and form a distinct closed cell with four sides. **Pentalonia.**

VI. Antennal tubercles short but not wedge shaped. Cauda large and long. VII.

— Antennal tubercles wedge shaped with the inner side formed into a tubercle or tooth. Cauda short. VIII.

VII. Antennal tubercles slightly gibbous. Antennae much longer than the body, nectaries strongly clavate. Wings with cubitus twice forked. **Amphorophora**

— Antennal tubercles as in the above genus. Nectaries tapering, wings with the cubital vein having but a single fork.....**Toxoptera**

VIII. Antennal tubercles with a strong tooth on the inner side. Nectaries almost cylindrical but tapering slightly. Cauda short and tapering. **Phorodon**

— Antennal tubercles with a prominent blunt projection forming the inner side. Nectaries slightly clavate, cauda tapering and with a knobbed tip. **Rhopalosiphum**

— Antennal tubercles with a distinct but not prominent blunt projection forming the inner side of the tubercle (more prominent in the apterous forms). Nectaries cylindrical and slightly curved at tip. Cauda short and tapering, being almost triangular in form.....**Myzus**

Gen. **Illinoia** new genus

type *M. liriondri* Monell

Antennae longer than the body, six segmented, and situated on prominent tubercles; spur of sixth segment as long or longer than the third; first segment strongly gibbous on inner side. Antennal tubercles and inner side not gibbous but tapering. Body elongate, wings long and medium stout; cubitus twice forked. Nectaries almost as long as the abdomen, broad at the base and tapering, being strongly constricted for a short distance back of the tip. Tip curved outwardly. Cauda ensiform, about one third the length of the abdomen and constricted in the middle. Anal plate broad and bluntly angled.

Gen. **Nectarosiphon** Schouteden

type *M. rubicola* Oestlund.

Antennae longer than the body, six segmented, and placed on fairly prominent tubercles; spur of sixth segment shorter than the third segment, first joint slightly gibbous on inner side. Front of head flat and narrow, Body elongate, wings large, nectaries about one fourth the length of the body with distal half dilated. Cauda one half the length of the nectaries and tapering. Anal plate triangular.

Gen. **Macrosiphum** Passerini

type *A. rosae* Linn.

Antennae six segmented, longer than the body and situated on fairly prominent tubercles; spur of sixth segment longer than third, first segment about as long as broad. Antennal tubercles slightly gibbous on the inner side. Inner surfaces at right angles to the head; forehead flat. Wings long, cubitus with two forks. Nectaries about one fourth the length of the body and tapering. Cauda as long as the nectaries and ensiform.

Gen. **Idiopterus** Davis

type *nephrelepidis* Davis.

Antennae about one and a half times as long as the body and placed on prominent tubercles; segments one and two large, the remaining segments long and slender, spur of sixth segment longer than the third. Antennal tubercles much larger than the second segment and with the upper inner side sharply angled. Body elongated, wings with the stigmal vein deeply rounded almost touching the discoidal and both lying in a broad dusky band. This gives the wing the appearance of having a closed triangular cell. Nectaries about one fifth the length of the body, straight and cylindrical. Cauda nearly as long as the nectaries and tapering.

Gen. **Microparsus** Patch

type *variabilis* Patch.

Antennae longer than the body and placed on prominent tubercles, spur of sixth segment longer than the third. First segment large and gibbous on the inner side. Antennal tubercles close together, head flat in front and merging into the tubercles. Wings long, cross veins heavy and cubitus usually with a single fork; stigma long and slender, hind wing with but a single cross vein. Nectaries about one fifth the length of the body and tapering. Cauda as long as the nectaries and broadly tapering. Anal plate slightly broader than the base of the cauda and triangular.

Gen. **Pentalonia** Coquerel

type *nigronervosa* Coq.

Antennae slender, longer than the body and placed on prominent tubercles; spur of sixth segment longer than the third, first segment strongly gibbous. Antennal tubercles gibbous at the upper inner edge. Body short and robust, wings long and with the oblique veins nearly at right angles to the costa; cubitus twice forked and at or slightly beyond the second fork combines with the radial sector, thus forming a closed cell; veins dark, hind wing with but a single cross vein. Nectaries about one-fifth the length of the body, and constricted in the middle and just behind the tip. Cauda but a knob situated on a broad base as in *Callipterini*. Anal plate broad with apex parallel to the base.

Gen. **Amphorophora** Buckton

type *ampullata* Buckton.

Antennae longer than the body and placed on prominent tubercles, third segment shorter than the spur of the sixth; first segment slightly gibbous on the inner side. Antennal tubercles on inner side rounded. Head broad in front and almost flat. Body elongate, abdomen stout. Wings large and regular, nectaries about one fourth the length of the body and very strongly vasiform. Cauda two thirds the length of the nectaries and tapering. Some species with cauda constricted about the middle.

Gen. **Toxoptera** Koch

type *aurantiae* Koch.

Antennae about as long as the body and placed on small but distinct tubercles, third segment shorter than the spur of sixth; first segment gibbous on the inner side. Body elongate, wings long and slender with the cubital vein having but a single fork. Nectaries one sixth the length of the body and cylindrical. Cauda nearly as long as the nectaries and ensiform. Anal plate broadly rounded.

Gen. **Phorodon** Passerini

type *A. humuli* Schrank

Antennae nearly as long as the body and placed on prominent tubercles, third segment longer than the spur of the sixth; first segment strongly gibbous. Antennal tubercles bearing a long tooth on the inner side, in the apterous forms this is more developed. Forehead narrow with a small tubercle bearing a frontal ocellus. Body elongate, wings long and broad with cubitus twice forked. Nectaries about one sixth the length of the body, cylindrical, and with a slight taper at the base. Cauda one half the length of the nectaries, broad at the base and tapering to a sharp point. Anal plate broadly rounded.

Gen. **Rhopalosiphum** Koch

type *A. persicae* Sulzer.

Antennae slightly longer than the body and placed on prominent wedge shaped tubercles, third segment about the same length as the spur of the sixth; first segment gibbous on the inner side. Antennal tubercles with a blunt tooth on the

inner side, the whole tubercle appearing as a wedge inserted between the head and the first antennal segment. Forehead narrow, outer edge of tubercles appear constricted. Body elongated, wings long. Nectaries about one fourth the length of the body and clavate at the outer end, cauda short, anal lobe broadly rounded.

Gen. **Myzus** Passerini

type *A. cerasi* Fabricius.

Antennae about as long as the body and situated on distinct tubercles, third segment as long as spur of sixth; first segment strongly gibbous. Antennal tubercles strongly gibbous on the inner side. Body robust, wings long and broad with cubitus twice forked. Nectaries about one fourth the length of the body, cylindrical, slightly constricted near the tip and slightly curved outward. Cauda less than half the length of the nectaries and tapering. Anal plate broadly rounded.

Tribe APHIDINI

The characters which separate this tribe from the previous are taken as follows. Antennae shorter than the body, or when as long as the body nectaries and cauda very short. Antennal tubercles, when present, are indistinct or else the nectaries and cauda are small. When nectaries are very long or large the development is limited and the other characters are used to place the genera. *Liosomaphis* has large nectaries but the antennae and cauda are very short. *Mastopoda* has the antennae more developed than other genera but the tubercles are wanting.

I. Nectaries strongly clavate.....II.
— Nectaries tapering and long.....III.
— Nectaries cylindrical and long.....IV.
— Nectaries very short or obscure.....V.
II. Antennae shorter than the body, spur of sixth segment not longer than third segment. Nectaries long and strongly clavate on one side. **Liosomaphis**
— Antennae slightly shorter than the body and with the spur of sixth segment much longer than third segment. Nectaries slightly swollen throughout the outer half.....**Hyadaphis**
III. Antennae about as long as the body, nectaries long and tapering and longer than the cauda.....**Aphis**
— Antennae shorter than the body, nectaries short and tapering and nearly half as wide as long. Cauda short but as long as the nectaries. **Pergandeida**
IV. Antennae as long as the body, nectaries nearly one fourth the length of the body. Tarsi and claws atrophied.....**Mastopoda**

— Antennae much shorter than the body, nectaries slightly constricted at the tip. . . . . **Coloradoa**
— Antennae shorter than the body and with but five segmented antennae. Nectaries short and cylindrical. . . . . **Cerosipha**
V. Nectaries prominent and readily distinguishable. . . . . VI.
— Nectaries very small and obscure. . . . . VII.
VI. Antennae shorter than the body, nectaries very stout and tapering. Cauda short and thick. . . . . **Pergandeida**
— Antennae shorter than the body, nectaries very short in above but slender and swollen in the middle . . . . . **Hyalopterus**
VII. Antennae much shorter than the body, nectaries cylindrical and as broad as long. Cauda much longer than the nectaries and tapering. . **Brachycolus**
— Antennae longer than the body, nectaries barely distinguishable, the end being trumpet shaped. Cauda not as long as wide and triangular. **Microsiphum**
— Antennae shorter than the body, nectaries little more than raised rings, and not flanged like the preceding genus. . . . . **Cryptosiphum**

Gen. **Liosomaphis** Walker

type *A. berberidis* Kaltenbach

Antennae shorter than the body and with indistinct antennal tubercles, spur of sixth segment about the same length as the segment; first segment gibbous on the inner side. Body elongate, abdomen robust, wings long and broad, cubitus twice forked. Nectaries about one fourth the length of the body and strongly clavate. Cauda less than one half the length of the nectaries and sharply tapering. Anal plate broadly rounded.

Gen. **Hyadaphis** Kirkaldy

Syn. *Siphocoryne passerini* preoccupied.

Antennae nearly as long as the body, third segment shorter than the spur of the sixth. Head with a slight projection at the inner base of each antenna. Body elongate, wings long and broad, venation regular. Nectaries about one fourth the length of the body and clavate in the middle. Cauda triangular short and rounded at the tip. Anal plate broad half moon shaped.

Gen. **Aphis** Linnaeus

type *A. sambuci* Linn.?

Antennae as long as the body, spur of sixth segment three times as long as the segment and as long as the third segment. Body elongated, abdomen robust. Wings broad and stout, with cubitus twice forked. Nectaries about one fourth the length of the body, somewhat slender and tapering. Cauda one fourth the length of the nectaries, stout and set on a broad base. Tip broadly rounded.

Gen. **Mastopoda** Oestlund

type *pteridis* Oestlund.

Antennae about as long as the body, third segment shorter than the spur of the sixth; first segment gibbous on the inner side. Forehead nearly flat, body elongate, abdomen robust. Wings long and slender, nectaries about one fourth the length of the body and cylindrical. Cauda very short and conical, anal plate broadly rounded. The atrophied tarsi and claws of this genus are the most distinguishing characters.

Gen. **Coloradoa** new genus

type *A. rufomaculata* Wilson.

Antennae about two thirds the length of the body, third segment longer than the spur of the sixth which is only about twice as long as the sixth. Wings moderately long, nectaries one sixth as long as the body, cylindrical at the base and slightly clavate at the end as in *Rhopalosiphum*. Cauda two thirds as long as the nectaries and tapering; tip blunt. Caudal plate broadly rounded.

Gen. **Cerosipha** Del Guercio

type *passerinina* Del Guerc.

Antennae shorter than the body and with but five segments and spur, third segment longer than the spur of the fifth. Forehead nearly flat but slightly raised in the center. Body elongate, abdomen the widest part of body. Wings long, medium wide, wing venation regular with twice forked cubitus. Nectaries about one tenth the length of the body and cylindrical, with a very slight taper. Cauda slightly shorter than the nectaries and tapering to a round point.

Gen. **Pergandeida** Schouteden

type *ononidis* Schout.

Antennae about as long as the body, spur of sixth segment as long as the third segment. Forehead with a prominent tubercle supporting the frontal ocelli, and slightly raised at the base of the antennae. Body elongated, stout; wings low and broad with twice forked cubitus. Nectaries short stout and tapering. Cauda as long as nectaries and broadly rounded at the tip. Anal plate broadly rounded.

Gen. **Hyalopterus** Koch

type *aurantiae* Koch.

Antennae shorter than the body, third segment as long as the spur of the sixth; first segment strongly gibbous on the inner side. Frontal ocelli prominent, forehead slightly raised at the base of each antenna. Body long and slender, wings also long and slender with cubitous twice forked. Nectaries very short and slender, being slightly swollen in the middle. Cauda twice as long as the nectaries and tapering to a blunt point, slightly constricted near the middle. Anal plate broadly rounded.

Gen. **Brachycolus** Buckton

type *A. stellariae* Hardy.

Antennae shorter than the body, third segment as long as the spur of the sixth; first antennal joint slightly gibbous. Body slender, wings long and slender and with the cubitus twice forked. Nectaries very short, being as long as broad and cylindrical. Cauda about twice as long as the nectaries and slender, tapering to a blunt point. Anal plate rounded and not distinct from the body.

Gen. **Microsiphum** Cholodkovsky

type *ptarmicae* Cholod.

Antennae about as long as the body and set on distinct tubercles, spur of sixth segment six times as long as the segment and longer than the third segment, first segment slightly gibbous on the inner side. Forehead broad, body large and robust. Wings long and broad, cubitus twice forked. Nectaries very short, being slightly shorter than the second antennal segment and flanged at the end like that of a horn. Cauda wide, exceedingly short and triangular in form. Anal plate barely distinguishable as a broad elevation. The only American form of this genus is the species which T. A. Williams called *Cryptosiphum canadense*, taken on *Artemisae ludovicianae*.*

* Special Bull. No. 1. Dept. of Entomology, University of Nebraska, July 8, 1891.

Gen. **Cryptosiphum** Buckton

type *artemisae* Buck.

Antennae shorter than the body, spur of sixth segment shorter than the third segment and about one and one half times as long as the sixth. Forehead flat, frontal ocelli not prominent. Body robust, wings long with the cubitus twice forked. Nectaries little more than pores with the edges slightly raised. Cauda short and tapering, anal plate rounded.

All of the genera given in this paper may be found with the original citation listed in the Entomological News for April 1910, pp. 147–156.

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